



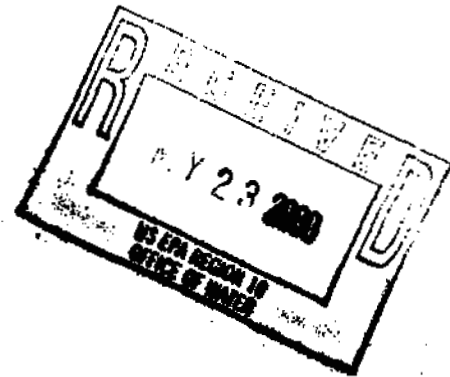
STATE OF IDAHO
DIVISION OF
ENVIRONMENTAL QUALITY

1410 North Hilton • Boise, Idaho 83708-1255 • (208) 373-0502

Dirk Kempthorne, Governor
C. Stephen Allred, Administrator

May 18, 2000

Chuck Clarke, Administrator
U.S. Environmental Protection Agency-Region 10
1200 Sixth Avenue
Seattle, WA 98101



RE: Issuance of Jim Ford and Cottonwood Creek TMDLs

Dear Mr. Clarke:

Enclosed are copies of the Jim Ford and Cottonwood Creek TMDLs prepared jointly by the Idaho Division of Environmental Quality, the Nezperce Tribe, and your agency. With your signature these can be considered completed and ready for implementation. I ask that you please provide us with three (3) photocopies each of the issuance letters with all three signatures for our records.

If you have any questions, please call me at 208-373-0194.

Sincerely,

A handwritten signature in cursive script, appearing to read "Michael McIntyre" with a flourish at the end.

David E. Mabe
State Water Quality Program Administrator

DEM:DE:bmm

Enclosures

cc: Christine Psyk, EPA-Region 10 (w/o enc.)
Leigh Woodruff, EPA IOO (w/o enc.)
Jim Bellaty, Regional Administrator, IDEQ Lewiston Regional Office (w/o enc.)
John Cardwell, Regional Water Quality Manager, IDEQ Lewiston Reg Office (w/o enc.)
Doug Conde, IDEQ Attorney General (w/o enc.)
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Don Essig, IDEQ TMDL Program Specialist (w/o enc.)

Total Maximum Daily Load (TMDL) for Cottonwood Creek Watershed

Chuck Clarke
Signature

6-6-2000
Date

Chuck Clarke,
Reg. Administrator,
U.S. EPA, Region 10

Samuel N. Penney
Signature

5-5-2000
Date

Samuel N. Penney,
Chairman,
Nez Perce Tribe

C. Stephen Allred
Signature

5-17-2000
Date

C. Stephen Allred,
Administrator,
Idaho Division of Environmental Quality

**United States
Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, Washington 98101**

**Total Maximum Daily Load (TMDL)
For
Jim Ford Creek Watershed**

In compliance with the provisions of the Clean Water Act, 33 U.S.C. § 1251 et seq., as amended by the Water Quality Act of 1987, P.L. 100-4, the Environmental Protection Agency, the State of Idaho, and the Nez Perce Tribe are jointly establishing Total Maximum Daily Loads (TMDL) for the following §303(d) listed waterbodies (and tributaries) and pollutants in the Jim Ford Creek Watershed.

Jim Ford Creek Watershed Total Maximum Daily Load	
§303(d) Listed Water	TMDLs
Jim Ford Creek #3288	Sediment, Temperature, Nutrients, Dissolved Oxygen, Pathogens (Bacteria)
Grasshopper Creek # 3289	Temperature, Nutrients, Dissolved Oxygen, Pathogens (Bacteria)

These 9 TMDLs have been established to ensure comply with water quality standards which apply to these waters. The joint establishment of these TMDLs does not and shall not be utilized or construed to establish, waive or otherwise affect any claims of sovereignty, jurisdiction, or other authorities of the Environmental Protection Agency, the State of Idaho or the Nez Perce Tribe.

These TMDLs shall become effective immediately.

Jim Ford Creek Total Maximum Daily Load (TMDL)

prepared for

Jim Ford Creek Watershed Advisory Group

March 2000

**Jim Ford Creek Total Maximum Daily Load
(TMDL)
Errata Sheet
June 2, 2000**

This errata sheet serves as a replacement page for the following:

- Page 1-8, Section 1.4
- Executive Summary Loading Table (page 1-8) for Bacteria and Total Phosphorus

These changes are to be incorporated into the March 2000 Jim Ford Creek Total Maximum Daily Load. The text below replaces the information presently in the Jim Ford Creek TMDL.

Section 1-4, Page 1-8

Replacement Text:

A loading analysis was performed on using instream fecal coliform concentrations, measured at seven sites in the Jim Ford Creek watershed and using flow estimate. Flow estimates for four sites were derived from a relationship established between gage levels and flow measurements. Flow estimates for the other three sites were modeled. Load capacity was considered for both Idaho's acute and chronic water quality criteria for fecal coliform during the primary contact recreation season (May - September), which was determined the critical time period. An explicit 20% margin of safety (MOS) was added to these target criteria to address uncertainties. No TMDL for secondary contact recreation was necessary due to the low bacteria levels below Idaho water quality criteria during the secondary contact recreation period (October - April).

The analysis indicates that load reduction ranging from 33% to 82% are necessary in non-point source loads to the upper portions and tributaries of Jim Ford Creek. A drainpipe installed under the City of Weippe STP lagoon was evaluated as a source of pollutant load to Grasshopper Creek using the limited sampling conducted in 1999. The available sampling data showed that the underdrain was a source of fecal coliform to Grasshopper Creek. Because the City of Weippe will be eliminating the underdrain discharge from Grasshopper Creek, a WLA of 0lbs/day is set for the underdrain.

A comparison of load reduction using the same procedures both with E.coli data instead of fecal coliform yielded similar load reductions.

**Jim Ford Creek Total Maximum Daily Load
(TMDL)
Errata Sheet
June 6, 2000**

This errata sheet serves as a replacement page for the following:

- Appendix J, page J-1, last paragraph
- Appendix J, page J-2, Table J-1
- Appendix J, page J-3, Table J-2

These changes are to be incorporated into the March 2000 Jim Ford Creek Total Maximum Daily Load. The text and tables below replace the information presently in the Jim Ford Creek TMDL.

**Appendix J, Page J-1, last paragraph
Replacement Text**

The existing nutrient load from the WWTPs is calculated using the same method. The main difference is that the measured WWTP discharge values are used to estimate the 50th percentile flow rather than USGS regional regression equations. The only subwatersheds that have contributions from point sources are Grasshopper Creek and mainstem Jim Ford Creek downstream at Weippe.

**Appendix J, page J-2, Table J-1
Replacement Table**

Table J-1. TMDL Loading Analysis Results for Total Phosphorous (units in pounds per month)

Subwatershed	Number of samples #	Load Capacity	Existing Load	Existing Waste Load	Non-point source Load Allocation	Non-point source Load Reduction	Non-point source % Reduction
Jim Ford Creek near mouth	43	888	1056	none	888	552	23
Winter Creek	14	161	114	none	161	0	0
downstream Weippe	40	368	506	30	353	118	24
Grasshopper Creek	17	145	204	1.3	144	11	6
upstream Weippe	18	331	565	none	331	189	33
Heywood Creek	13	100	238	none	100	77	32
Miles/Wilson Creeks	14	123	267	none	123	69	26

= used to calculate the 84th percentile nitrogen concentration over averaging period

Appendix J, page J-3, Table J-2

Replacement Table

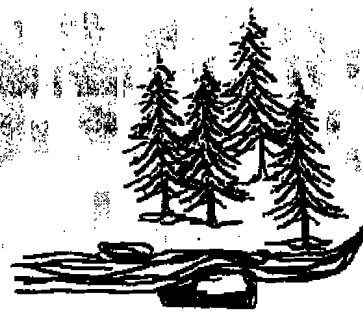
Table J-2. TMDL Loading Analysis Results for Total Inorganic Nitrogen (units in pounds per month)

Subwatershed	Number of samples #	Load Capacity	Existing Load	Non-point source Load Reduction	Non-point source % Reduction
Jim Ford Creek near mouth	43	2665	602	0	0
Winter Creek	14	301	51	0	0
downstream Weippe	40	1105	647	0	0
Grasshopper Creek	17	435	56	0	0
upstream Weippe	18	994	197	0	0
Heywood Creek	13	301	64	0	0
Miles/Wilson Creeks	14	369	94	0	0

= used to calculate the 84th percentile nitrogen concentration over averaging period

Executive Summary Loading Table Page 1-8

Pollutant	Pollutant Source	Target	Load Capacity	Existing Load	Load Reduction
Total Phosphorus	Non-Point Sources Activities	<ul style="list-style-type: none"> • 20% MOS • 0.075 mg/l during the growing season of April through October 	Total Phosphorus Reduction Targets		
			<u>Sub-Watershed</u>	<u>Phosphorus Reduction Target</u>	
			Miles/Wilson	26%	
			Heywood Creek	32%	
			Upstream of Weippe	0%	
			Grasshopper Creek	5%	
			Downstream of Weippe	24%	
			Winter Creek	0%	
			Lower Jim Ford Creek	23%	
Bacteria	Underdrain from Weippe WWTP and Nonpoint Sources	<ul style="list-style-type: none"> • 20% MOS in target • Primary Contact Recreation (May -Sept) • 400 cfu/100 mL instantaneous and 40 cfu/100 mL 30-day geometric mean target. 	Bacteria Reduction Targets		
			<u>Sub-Watershed</u>	<u>Bacteria Reduction Target</u>	
			Mouth of Jim Ford	0%	
			Miles/Wilson	70%	
			Heywood Creek	62%	
			Downstream of Weippe	47%	
			Upstream of Weippe	82%	
			Grasshopper Creek	33%	
			Winter Creek	62%	
			Weippe WWTP (underdrain WLA) = 0lbs/day		



JIM FORD CREEK TOTAL MAXIMUM DAILY LOAD WATERSHED MANAGEMENT PLAN

Jointly Prepared by the:

**Idaho Division of Environmental Quality
Nez Perce Tribe
Environmental Protection Agency**

in consultation with the:

Jim Ford Creek Watershed Advisory Group

March 2000

PREPARERS AND CONTRIBUTORS

This document was developed after numerous discussions to reach a clear understanding and a consensus of opinion on the relatively difficult issues associated with water quality protection and restoration by the following dedicated citizens living and working in the watershed and the federal, state and tribal staff members associated with the project.

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Gene & Linda Applington	Recreation
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Bud Bonner	Clearwater County
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Members of the participating governmental agencies that worked with the Jim Ford Creek WAG on the project are indebted to the commitment and sound advice provided by the Group, and wish to offer our sincere thanks for their efforts. They generously volunteered considerable time and effort in assessing water quality problems and planning water quality improvements. Their knowledge of local conditions was invaluable.

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Acronyms/Abbreviations and Glossary

ACRONYM/ ABBREVIATION	FULL NAME
ACP	Alternative Conservation Program
BAG	Basin Advisory Group
bcfu	billion colony forming units
BMP or BMPs	Best Management Practice(s)
BOD or BOD5	Biological Oxygen Demand or 5-day Biological Oxygen Demand
BURP	Beneficial Use Reconnaissance Project
°C	degrees celsius
CAFO	Confined Animal Feeding Operations
CBOD	Carbonaceous Biochemical Oxygen Demand
CFO	Confined Feeding Operations
CFR	Code of Federal Regulations
cfs	cubic feet per second
cfu	colony forming units
CWA	Clean Water Act
CSWCD	Clearwater Soil and Water Conservation District
DO	dissolved oxygen
DMR or DMRs	Discharge Monitoring Report (s)
<i>E. coli</i>	Escherichia coli
EPA	United States Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, Trichoptera Insect Orders
ESA	Endangered Species Act
FPA	Idaho Forest Practices Act
ft	feet
GIS	Geographic Information System
GPS	Global Positioning System
HI	Habitat Index
HUC or HUCs	Hydrologic Unit Code(s)
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Division of Environmental Quality
IDFG	Idaho Department of Fish and Game

ACRONYM/ ABBREVIATION	FULL NAME
IDHW	Idaho Department of Health and Welfare
IDL	Idaho Department of Lands
IDWR	Idaho Department of Water Resources
ISCC	Idaho Soil Conservation Commission
kg	kilogram
L	liter
LA	Load Allocation
lbs	pounds
LRO	Lewiston Regional Office
LC	Loading Capacity (which TMDE = Assimilative Capacity)
MBI	Macroinvertebrate Biotic Index
MGD	million gallons per day
m	meter
mg	milligrams
mg/L	milligrams per liter
mL	milliliter
MOS	Margin of Safety
µg	microgram
µg/L	micrograms per liter
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NPS	nonpoint source
NPT	Nez Perce Tribe
NRCS	Natural Resources Conservation Service
NTU	nephelometric turbidity unit
SAWQP	State Agricultural Water Quality Program
SCC	Soil Conservation Commission
SCD or SCDs	Soil Conservation District(s)
SCS	Soil Conservation Service
SSOCs	Stream Segments of Concern
SWCD	Soil and Water Conservation District

x

ACRONYM/ ABBREVIATION	FULL NAME
SWPP	Storm Water Pollution Prevention Plan
T/yr	tons per year
TKN	total kjeldahl nitrogen
TMDL	Total Maximum Daily Load
TP	total phosphorus
TSS	total suspended solids/sediment
UAA	Use Attainability Assessment
USC	United States Code
U of I	University of Idaho
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WAG	Watershed Advisory Group
WBAG	Water Body Assessment Guidance
WLA	Waste Load Allocation
WQLS	Water Quality Limited Segment
WWTP	Wastewater Treatment Plant
yr	year

GLOSSARY

Alevin - Newly hatched salmonid still dependent on yolk sac; remains in stream bed gravel until yolk sac is absorbed.

Aeration - a process by which a water body secures oxygen directly from the atmosphere, the gas then enters into biochemical oxidation reactions in water.

Anadromous - Fishes, such as salmon and sea-run trout, that live part or the majority of their lives in the salt water but return to fresh water to spawn.

Aquifer - a water-bearing bed or stratum of permeable rock, sand, or gravel capable of yielding considerable quantities of water to wells or springs.

Adsorption - the adhesion of one substance to the surface of another; clays, for example, can adsorb phosphorus and organic molecules.

Aerobic - describes life or processes that require the presence of molecular oxygen.

Algae - small aquatic plants that occur as single cells, colonies, or filaments.

Alluvial - unconsolidated recent stream deposition.

Ambient - surrounding, external, or unconfined conditions.

Anaerobic - describes processes that occur in the absence of molecular oxygen.

Anoxia - the condition of oxygen deficiency.

Antidegradation - A federal regulation requiring the States to protect high quality waters. Waters standards may be lowered to allow important social or economic development only after adequate public participation. In all instances, the existing beneficial uses must be maintained.

Aquatic - growing, living, or frequenting water.

Assimilative Capacity - an estimate of the amount of pollutants that can be discharged to and processed by a waterbody and still meet the state water quality standards. It is the equivalent of the Loading Capacity which is the equivalent of the TMDL for the waterbody.

Basalt - a fine-grained, dark-colored extrusive igneous rock.

Bedload - material, generally of sand size or larger, carried by a stream on or immediately above (3") its bed.

Beneficial uses - any of the various uses which may be made of the water of an area, including, but not limited to, domestic water supplies, industrial water supplies, agricultural water supplies, navigation, recreation in and on the water, wildlife habitat, and aesthetics.

Benthic organic matter - the organic matter on the bottom of the river.

Benthic - pertaining to or living on the bottom or at the greatest depths of a body of water.

Benthos - macroscopic (seen without aid of a microscope) organisms living in and on the bottom sediments of lakes and streams. Originally, the term meant the lake bottom, but it is now applied almost uniformly to the animals associated with the substrate.

Best Management Practice (BMP) - a measure determined to be the most effective, practical means of preventing or reducing pollution inputs from point or nonpoint sources in order to achieve water quality goals.

Biochemical oxygen demand (BOD) - the rate of oxygen consumption by organisms and chemical reactions during the decomposition (= respiration) of organic matter, expressed as grams oxygen per cubic meter of water per hour.

Biomass - the weight of biological matter. Standing crop is the amount of biomass (e.g. fish or algae) in a body of water at a given time. Often measured in terms of grams per square meter of surface.

Biomass Accumulation - a measure of the density and lateral and downstream extent of plant growth across a waterbody.

Biota - All plant and animal species occurring in a specified area.

Cfs - cubic feet per second, a unit of measure for the rate of discharge of water. One cubic foot per second is the rate of flow of a stream with a cross section of one square foot which is flowing at a mean velocity of one foot per second. It is equal to 448.8 gallons per minute, 0.646 million gallons per day, or 1.98 acre-foot per day.

Coliform bacteria - a group of bacteria predominantly inhabiting the intestines of man and animal but also found in soil. Coliform bacteria are commonly used as indicators of the possible presence of pathogenic organisms.

Colluvium - material transported to a site by gravity.

Decomposition - the transformation of organic molecules (e.g. sugar) to inorganic molecules (e.g. carbon dioxide and water) through biological and non-biological processes.

Designated Beneficial Use or Designated Use - Those beneficial uses assigned to identified waters in Idaho Department of Health and Welfare Rules, Title 1, Chapter 2, "Water Quality Standards and Wastewater Treatment Requirements", Sections 110. through 160. and 299., whether or not the uses are being attained."

Diel - A 24-hour period that includes a day and adjoining night.

Dissolved oxygen - commonly abbreviated DO, it is the amount of oxygen dispersed in water and is usually expressed as mg/L (ppm). The amount of oxygen dissolved in water is affected by temperature, elevation, and total dissolved solids.

Ecology - scientific study of relationships between organisms and their environment; also defined as the study of the structure and function of nature.

Ecosystem - a complex system composed of a community of flora and fauna taking into account the chemical and physical environment with which the system is interrelated; ecosystem is usually defined to include a body of water and its watershed.

Effluent - a discharge into the environment; often used to refer to discharge of untreated, partially treated, or treated pollutants into a receiving water body.

Environment - collectively, the surrounding conditions, influences, and living and inert matter that affect a particular organism or biological community.

Eolian - windblown.

Erosion - the wearing away of areas of the earth's surface by water, wind, ice, and other forces. **Culturally-induced erosion** is that caused by increased runoff or wind action due to the work of man in deforestation, cultivation of the land, overgrazing, and disturbance of the natural drainage; the excess of erosion over that normal for the area.

Eutrophic - from Greek for "well-nourished," describes a body of water of high photosynthetic activity and low transparency.

Eutrophication - the process of physical, chemical, and biological changes associated with nutrient, organic matter, and silt enrichment and sedimentation of a body of water. If the process is accelerated by man-made influences, it is termed cultural eutrophication. Eutrophication refers to natural addition of nutrients to waterbodies and to the effects of artificially added nutrients.

Existing Beneficial Use or Existing Use - Those beneficial uses actually attained in waters on or after November 28, 1975, whether or not they are designated for those waters in Idaho Department of Health and Welfare Rules, Title 1, Chapter 2, "Water Quality Standards and Wastewater Treatment Requirements."

Fecal Streptococci - a species of spherical bacteria including pathogenic strains found in the intestines of warm blooded animals.

Feedback Loop - a component of a watershed management plan strategy that provides for accountability on targeted watershed goals.

Flow - the quantity of water that passes a given point in some time increment.

Gradient - the slope of the stream bed profile.

Granitic - derived from granite; coarse to medium grained intrusive igneous rock.

Groundwater - water found beneath the soil surface; saturates the stratum at which it is located; often connected to surface water.

Growth Rate - the amount of new plant tissue produced per a given time unit of time. It is also a measure of how quickly a plant will develop and grow.

Habitat - a specific type of place that is occupied by an organism, a population or a community.

Headwater - the origin or beginning of a stream.

Hydrologic basin - The area of land drained by a river system, a reach of a river and its tributaries in that reach, a closed basin, or a group of streams forming a drainage area. There are six basins described in the Nutrient Management Act (NMA) for Idaho -- Panhandle, Clearwater, Salmon, Southwest, Upper Snake, and the Bear Basins.

Hydrologic cycle - the circular flow or cycling of water from the atmosphere to the earth (precipitation) and back to the atmosphere (evaporation and plant transpiration). Runoff, surface water, groundwater, and water infiltrated in soils are all part of the hydrologic cycle.

Impervious - a surface, such as a pavement, that rain cannot penetrate.

Influent - the flow into a process, facility, or larger body of water.

Inorganic - materials not containing carbon and hydrogen, and not of biologic origin.

Irrigation return flow - surface and subsurface water which leaves the field following the application of irrigation water.

Land Application - a process or activity involving application of wastewater, surface water, or semi-liquid material to the land surface for the purpose of disposal, pollutant removal, or groundwater recharge.

Limiting factor - a chemical or physical condition that determines the growth potential of an organism, can result in less than maximum or complete inhibition of growth, typically results in less than maximum growth rates.

Limnology - scientific study of fresh water, especially the history, geology, biology, physics, and chemistry of lakes.

Load Allocation - The amount of pollutant that nonpoint sources can release to a waterbody.

Loading - the quantity of a substance entering a receiving stream, usually expressed in pounds (kilograms) per day or tons per month. Loading is calculated from flow (discharge) and concentration.

Loading Capacity - the maximum amount of pollutant a waterbody can safely assimilate without violating state water quality standards. It is also the equivalent of a TMDL.

Loam - moderately coarse, medium and moderately fine-textured soils that include such textural classes as sandy loam, fine sandy loam, very fine sandy loam, silt loam, silt, clay loam, sandy clay loam and silty clay loam.

Loess - is defined as a uniform eolian (wind-blown) deposit of silty material having an open structure and relatively high cohesion due to cementation by clay or calcareous material at the grain contacts.

Macroinvertebrates - aquatic insects, worms, clams, snails, and other animals visible without aid of a microscope, that may be associated with or live on substrates such as sediments and macrophytes. They supply a major portion of fish diets and consume detritus and algae.

Macrophytes - rooted and floating aquatic plants, commonly referred to as water weeds. These plants may flower and bear seed. Some forms, such as duckweed and coontail (*Ceratophyllum*), are free-floating forms without roots in the sediment.

Margin of safety - Commonly abbreviated MOS. An implicit or explicit component of water quality modeling that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving waterbody.

Mean - the arithmetic mean is the most common statistic familiar to most people. The mean is calculated by summing all the individual observations or items of a sample and dividing this sum by the number of items in the sample. The geometric mean is used to calculate bacterial numbers. The geometric mean is a back-transformed mean of the logarithmically transformed variables.

Meter - the basic metric unit of length; 1 meter = 39.37 inches or 3.28 feet.

Milligrams per liter (mg/L) - concentration equal to 0.001 grams in substance weight per liter capacity.

Million gallons per day (MGD) - a unit of measure for the rate of discharge of water, often used to measure flow at WWTPs. It is equal to 1.55 cubic feet per second.

Monitoring - the process of watching, observing, or checking (in this case water). The entire process of a water quality study including: planning, sampling, sample analyses, data analyses, and report writing and distribution.

Mouth - the location where a water body flows into a larger waterbody.

National Pollution Discharge Elimination System (NPDES) - a national program from the Clean Water Act for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits to discharge pollutants to waters of the United States, including pretreatment requirements.

Nitrogen - a nutrient essential to plant growth, often in more demand than available supply.

Nonpoint Source - A dispersed source of pollutants such as a geographical area on which pollutants are deposited or dissolved or suspended in water applied to or incident on that area, the resultant mixture being carried by runoff into the waters of the state. Nonpoint source activities include, but are not limited to irrigated and non-irrigated lands used for grazing, crop production and silviculture; log storage or rafting; urban areas; construction sites; recreation sites; and septic tank disposal fields.

Nuisance - anything which is injurious to the public health or an obstruction to the free use, in the customary manner, of any waters of the state.

Nutrient - an element or chemical essential to life, such as carbon, oxygen, nitrogen, and phosphorus.

Nutrient cycling - the flow of nutrients from one component of an ecosystem to another, as when macrophytes die and release nutrients that become available to algae (organic to inorganic phase and return).

Oligotrophic - "poorly nourished," from the Greek. Describes a body of water with low plant productivity and high transparency.

Organic matter - molecules manufactured by plants and animals and containing linked carbon atoms and elements such as hydrogen, oxygen, nitrogen, sulfur, and phosphorus.

Orthophosphate - a form of soluble inorganic phosphorus which is directly utilizable for algal growth.

Oxygen-demanding materials - those materials, usually organic, in a waterbody which consume oxygen during decomposition or transformation. Sediment can be an oxygen-demanding material.

Parameter - a variable quantity such as temperature, dissolved oxygen, or fish population, that is the subject of a survey or sampling routine.

Partitioning - the sharing of limited resources by different races or species; use of different parts of the habitat, or the same habitat at different times.

Pathogen - any disease-causing organism.

Periphyton - attached organisms, usually algae, growing on the bottom or other submersed substrates in a waterway.

pH - a measure of the concentration of hydrogen ions of a substance, which ranges from very acid ($\text{pH} = 1$) to very alkaline ($\text{pH} = 14$). $\text{pH} 7$ is neutral, and most lake waters range between 6 and 9. pH values less than 7 are considered acidic, and most life forms cannot survive at pH of 4.0 or lower.

Phased TMDL - A TMDL which identifies interim load allocations with further monitoring to gauge success of management actions in achieving load reduction goals and the effect of actual load reductions on the water quality of a waterbody. Under a phased TMDL, the TMDL has load allocations and wasteload allocations calculated with margins of safety to meet water quality standards.

Phosphorus - a nutrient essential to plant growth, typically in more demand than the available supply.

Phytoplankton - microscopic algae and microbes that float freely in open water of lakes and oceans.

Point source pollution - the type of water quality degradation resulting from the discharges into receiving waters from sewers and other identifiable "points." Common point sources of pollution are the discharges from industrial and municipal wastewater treatment plants.

Pretreatment - the reduction of the amount of pollutants, the elimination of pollutants, or the alteration of the nature of pollutant properties in wastewater prior to or in lieu of discharging or otherwise introducing such pollutants into a WWTP.

Primary productivity - the rate at which algae and macrophytes fix or convert light, water, and carbon dioxide to sugar in plant cells. Commonly measured as milligrams of carbon per square meter per hour.

Reach - a stream section with fairly homogenous characteristics.

Respiration - process by which organic matter is oxidized by organisms, including plants, animals, and bacteria. The process releases energy, carbon dioxide, and water.

Riffle - A shallow, gravelly area of stream bed with swift current.

Riparian - associated with aquatic (streams, rivers, lakes) habitats. Living or located on the bank of a waterbody.

Runoff - the portion of rainfall, melted snow, or irrigation water that flows across the surface or through underground zones and eventually runs into streams.

Sediment - bottom material in a body of water that has been deposited after the formation of the basin. It originates from remains of aquatic organism, chemical precipitation of dissolved minerals, and erosion of surrounding lands.

Settleable solids - the volume or weight of material that settles out of a liter of water in one hour.

Specific conductance - also known as specific conductivity. It is a numerical expression of the ability of an aqueous solution to carry electric current, expressed in $\mu\text{mhos/cm}$ at 25°C . Conductivity is defined as the reciprocal of the resistivity normalized to a 1 cm cube of liquid at a specific temperature and is an indirect measure of dissolved solids.

Stagnation - the absence of mixing in a waterbody

Stochastic - of, or pertaining to, a process involving a randomly determined sequence of observations each of which is considered as a sample of one element from a probability distribution.

Stream Segments of Concern (SSOCs) - Stream segments nominated by the public and designated by a committee whose members are appointed by the Governor.

Storm water runoff - Surface water that washes off land after a rainstorm. In developed watersheds it flows off roofs and pavement into storm drains which may feed directly into the stream; often carries pollutants.

Subbasin - Smaller geographic management areas within a hydrologic basin delineated for purposes of addressing site specific conditions.

Subwatershed - smaller geographic management areas within a watershed delineated for purposes of addressing site specific situations.

Suspended sediments - Fine mineral or soil particles that remain suspended by the current until deposited in areas of weaker current. They create turbidity and, when deposited, can cover fish eggs or alevins.

Thalweg - The center of the current.

Threatened species - a species, determined by the U.S. Fish and Wildlife Service, which are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

TMDL - Total Maximum Daily Load. $\text{TMDL} = \text{LA} + \text{WLA} + \text{MOS}$. A TMDL is the equivalent of the Loading Capacity which is the equivalent of the assimilative capacity of a waterbody.

Total suspended solids (TSS) - the material retained on a 2.0 micron filter after filtration.

Tributary - a stream feeding into a larger stream or lake.

Trophic state - level of growth or productivity of a lake as measured by phosphorus content, chlorophyll a concentrations, amount of aquatic vegetation, algal abundance, and water clarity.

Turbidity - a measure of the extent to which light passing through water is scattered due to suspended materials. Excessive turbidity may interfere with light penetration and minimize photosynthesis, thereby causing a decrease in primary productivity. It may alter water temperature and interfere directly with essential physiological functions of fish and other aquatic organisms, making it difficult for fish to locate a food source.

Vadose zone - The zone containing water under less pressure than that of the atmosphere, including soil water, intermediate vadose water, and capillary water. This zone is limited above by the land surface and below the surface of the zone of saturation, that is, the water table.

Wash Load - that part of the total sediment load composed of all particles finer than limiting size, which is normally washed into and through the reach under consideration without settling.

Waste Load Allocation (WLA) - a portion of receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. It specifies how much pollutant each point source can release to a waterbody.

Water column - water between the interface with the atmosphere at the surface and the interface with the sediment layer at the bottom. Idea derives from vertical series of measurements (oxygen, temperature, phosphorus) used to characterize water.

Water Pollution - Any alteration of the physical, thermal, chemical, biological, or radioactive properties of any waters of the state, or the discharge of any pollutant into the waters of the state, which will or is likely to create a nuisance or to render such waters harmful, detrimental or injurious to public health, safety or welfare, or to fish and wildlife, or to domestic, commercial, industrial, recreational, aesthetic, or other beneficial uses.

Water Quality Limited Segment (WQLS) - any water body, or definable portion of water body, where it is known that water quality does not meet applicable water quality standards, and/or is not expected to meet applicable water quality standards.

Water Quality Management Plan - a state or area-wide waste treatment management plan developed and updated in accordance with the provisions of the Clean Water Act.

Water quality modeling - the input of variable sets of water quality data to predict the response of a lake or stream.

Water table - the upper surface of groundwater; below this surface the ground is saturated with water.

Watershed - a drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation. The whole geographic region contributing to a water body.

Wetlands - lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Wetlands must have the following three attributes: (1) at least periodically, the land supports predominately hydrophytes; (2) the substrate is predominately undrained hydric soil; and (3) the substrate is on soil and is saturated with water or covered by shallow water at some time during the growing season of each year.

1.0 EXECUTIVE SUMMARY

WATER QUALITY CONCERNS AT A GLANCE

<i>§303(d) Listed Segments:</i>	<i>Jim Ford Creek (#3171) ; Grasshopper Creek (#3172)</i>
<i>Pollutants of Concern:</i>	<i>Sediment, Temperature, Nutrients, Dissolved Oxygen, Pathogens, Ammonia, Oil and Grease, Habitat Modification and Flow</i>
<i>Designated and Existing Beneficial Uses:</i>	<i>Primary Contact Recreation, Secondary Contact Recreation, Agricultural Water Supply, Cold Water Biota, Domestic Water Supply, Salmonid Spawning (below waterfall)</i>
<i>Point Sources:</i>	<i>City of Weippe Wastewater Treatment Plant, Timberline High School Wastewater Treatment Plant, Hutchins Lumber Inc.</i>
<i>NonPoint Sources:</i>	<i>Non-irrigated croplands, timber harvest activities, urban runoff, grazing, hydropower, land development activities, septic systems</i>

Jim Ford Creek is a third order tributary of the Clearwater River in the southern part of Clearwater County, Idaho. The creek flows twenty miles northwest, from an elevation of 4,068 feet to 1,050 feet, at its confluence with the Clearwater River near Orofino, Idaho. It drains a 65,838 acre watershed that has two distinct portions. In the upper portion, Jim Ford Creek flows through rolling forested uplands and the Weippe prairie until it reaches the City of Weippe. Below Weippe, the creek enters into a narrow steep basalt canyon nearly fourteen miles in length. A 65 foot waterfall at the top of the canyon restricts fish passage upstream. Primary land uses in the watershed consist of timber production, grazing, and recreation in the entire watershed; dryland agriculture on the rolling Weippe prairie; and a small urban area at the City of Weippe. A small hydropower facility is located along the creek just downstream of the City of Weippe.

Section 303(d) of the Clean Water Act requires states to develop a Total Maximum Daily Load (TMDL) management plan for water bodies determined to be water quality limited. A TMDL documents the amount of pollutant a water body can assimilate without violating a state's water quality standards and allocates that load capacity to known point sources and nonpoint sources. TMDLs are the sum of the individual waste load allocations for point sources and load allocations for nonpoint sources, including a margin of safety and natural background conditions.

In 1994 Jim Ford Creek was classified as a high priority water quality limited segment under §303(d) of the Clean Water Act from its headwaters to the confluence with the Clearwater River. Grasshopper Creek, a tributary to Jim Ford Creek, was also classified as a water quality limited segment in 1994. Pollutants of concerns listed for Jim Ford Creek include: sediment, temperature, pathogens, nutrients, dissolved oxygen, ammonia, oil and grease, habitat modification, and flow. Pollutant of concern listed for Grasshopper Creek include nutrients, sediment, temperature, pathogens (bacteria), habitat modification and flow.

Idaho Water Quality Standards designate cold water biota, secondary recreation, primary contact recreation, and agricultural supply as beneficial uses for Jim Ford Creek. Salmonid spawning is an existing use for the lower portion of the watershed below a 65 foot waterfall located 14 miles upstream of the mouth. 1995 beneficial use studies indicates that Jim Ford Creek does not provide full support of beneficial uses because of macroinvertebrate population impairment in the upper prairie section and exceedances of temperature criteria in the lower canyon section. The status of beneficial uses based on 1997 and 1998 beneficial use studies has not been assessed pending revisions of the State's *Water Body Assessment Guidance* document.

Three point sources are permitted to discharge in the Jim Ford Creek watershed: the Weippe wastewater treatment plant; the Timberline High School wastewater treatment plant; and Hutchins Lumber Inc., which operates a sawmill and log yard. The Weippe wastewater treatment plant usually discharges into Jim Ford Creek from January to mid-June each year, and only when the instream flow of Jim Ford Creek provides dilution. The Timberline High School wastewater treatment plant typically discharges into Grasshopper Creek, a tributary of Jim Ford Creek. Hutchins Lumber Inc. is currently implementing stormwater runoff controls pursuant to an approved stormwater management plan.

The primary nonpoint sources of pollutants in the Jim Ford Creek watershed are grazing, timber harvest activities, non-irrigated croplands, urban runoff, land development activities and hydropower.

The upland and prairie portions of Jim Ford Creek and tributaries typically receive suspended sediment from eroding agricultural fields, unstable stream banks, and forest roads during rainfall and snow melt. Phosphorous and bacteria associated with the suspended sediment also enter the creek at these times. During the summer low flow periods, these portions of Jim Ford Creek experience temperature increases, algae growth, and low dissolved oxygen concentrations. Temperature and bacteria levels often exceed water quality criteria. Phosphorus is present in high enough concentrations to stimulate excessive aquatic plant growth that causes diurnal and seasonal fluctuations in dissolved oxygen concentrations that can impair aquatic life.

The canyon portion of Jim Ford Creek is impacted primarily by forest harvest activities and the quality of the water entering from the prairie portion upstream. Within the canyon, stream temperatures often exceed those recommended for cold water biota and salmonids. Results of a 1999 channel stability and habitat survey indicate excess cobble size bed material is likely impairing cold water biota and salmonid spawning beneficial uses in the stream reaches below the waterfall.

Since portions of Jim Ford Creek lie within the Nez Perce Reservation, a Memorandum of Agreement was developed between the Nez Perce Tribe, the U.S. Environmental Protection Agency, and the State of Idaho Division of Environmental Quality to develop the TMDL, with the advice of the Jim Ford Creek Watershed Advisory Group. In the Memorandum of Agreement, the parties agreed to utilize State of Idaho water quality standards for the development of the TMDL.

This TMDL examines whether the estimated load capacities for pollutants in Jim Ford Creek are currently exceeded. Targets, loading analyses, and load allocations are presented for sediment, temperature, nutrients/dissolved oxygen, and pathogens. Evaluation of available data indicates a TMDL is not necessary for oil and grease, fine sediment and ammonia. Data also indicates a need for a bacteria TMDL for primary recreation contact but not secondary recreation contact.

Water quality standards for the State of Idaho are intended to provide protection of designated beneficial uses. TMDL targets are based on these water quality standards. Numeric water quality criteria are used where they exist. Narrative water quality criteria have a numerical interpretation which are applied to Jim Ford Creek for sediment and nutrients. Load capacities reflect these water quality targets for Jim Ford Creek based on available or estimated instream flow data. Load allocations presented distribute the existing pollutant loading from both point and nonpoint sources within the watershed, based on available load capacity of Jim Ford Creek.

This following discussion explains how all the listed parameters were addressed in the TMDL. The Executive Summary Loading Table at the end of this Section summarizes pollutant and loading allocations.

1.1 Sediment

Existing data indicates fine sediment is not degrading the water quality of Jim Ford Creek; therefore, no TMDL is necessary for fine sediments. However, a channel stability analysis and habitat survey indicates coarse sediment is impairing salmonid spawning and rearing of lower Jim Ford Creek. The instream loading analysis suggests that to improve the condition of response reaches, the bedload transport rate in transport reaches needs to be reduced about 70%.

Sediment impairment likely results from a combination of increased sediment load and flood magnitude. However, until a more in-depth analysis of sediment and flow impacts is complete, a more definitive answer is not possible. The Jim Ford Creek Watershed and Technical Advisory Groups have committed to complete this analysis in the year 2000. Results of this analysis will be used to revise the sediment load reduction and allocation scheme presented herein.

Reducing coarse sediment delivery to lower Jim Ford Creek and timing of peak flood flows through best management practices will help improve the water quality of lower Jim Ford Creek. Future analysis of sediment sources and flow impacts will be used to help develop the sediment TMDL implementation plan.

1.2 Temperature

The Jim Ford Creek TMDL was established to address thermal loading (heat) for the protection of chinook salmon and steelhead spawning, and other cold water biota. The watershed was evaluated for cold water biota temperature in the upper watershed, and for salmonid spawning in the lower watershed below the falls.

This TMDL establishes percent reduction targets (instream temperature) for nonpoint sources in each subwatershed. These percent reduction targets are linked to "Percent Increase in Shade" targets for each subwatershed, thereby reducing the overall rate of increase in instream temperature throughout the watershed. Management activities within a watershed, such as removing riparian shade trees, harvesting of the conifer overstory, grazing in riparian areas, and introducing bedload sediment which results in increased surface area, can increase the amount of solar radiation reaching the stream.

The amount of heat energy (i.e. loading capacity) which would meet State water quality temperature standards in the creek was determined by applying a modeling technique. Model results indicate that a up to a 52% increase in shade is necessary in order to attain and maintain State water quality standards depending on stream reach. It is recognized that meeting the standards will best be accomplished by additionally promoting channel restoration that leads to a narrower, deeper channel, colder water contributions from improved segments upstream, and increases in base flow.

1.3 Nutrients/Dissolved Oxygen

The presence of visible nuisance algae growth and low dissolved oxygen levels indicate that Jim Ford Creek is impaired as a result of excess nutrients. Nuisance algae growths are present in the upper reaches of Jim Ford Creek, and low dissolved oxygen levels are present throughout the watershed.

The nutrient and dissolved oxygen TMDLs are combined. As part of these TMDLs, a key assumption is made that by meeting the instream nutrient target the dissolved oxygen water quality standard will be achieved as well. TMDL targets are established for both of these water quality parameters.

April 1 through October was selected as the averaging period for estimating the nutrient load capacity, existing load, and load reductions. The total inorganic nitrogen and total phosphorus targets were evaluated only during this period. Whereas the dissolved oxygen target applies year round as well.

The nutrient load capacities and existing loads were estimated by subwatershed in pounds per month during the months April through July when data are available. The estimated existing total phosphorus load exceeds the load capacity in all the subwatersheds except for Winter Creek. Total phosphorus needs to be reduced by about 25% across the watershed. The total phosphorus load of lower Jim Ford Creek needs to be reduced by 23%. Heywood and Miles/Wilson Creeks contribute the greatest amount of phosphorus to the mainstem and receive a phosphorus reduction of 32 and 26%, respectively. Because the majority of the TP load to Jim Ford Creek is from non-point sources, there are no point source load reductions required by this TMDL. For this TMDL, the point source waste load allocations is set at the existing measured nutrient load. The non-point sources are allocated all of the needed nutrient load reductions. This TMDL approach is supported by reasonable assurance because the non-point sources in the watershed

have committed to implementing BMPs to improve water quality in the watershed. In addition, a monitoring plan will be developed with the intent of measuring the amount and implementation of BMP and improvements in water quality.

1.4 Pathogens

A loading analysis was performed using instream fecal coliform concentrations, measured at seven sites in the Jim Ford Creek watershed and using flow estimates. Flow estimates for four sites were derived from a relationship established between gage levels and flow measurement. Flow estimates for the other three sites were modelled. Load capacity was considered at both Idaho's acute and chronic water quality criteria for fecal coliform during the primary contact recreation season (May through September), which was determined to be the critical time period. An explicit 20% margin of safety was added to these target criteria to address uncertainties. No TMDL for secondary contact recreation was necessary due to low bacteria levels below water quality criteria during the secondary contact recreation period (October through April).

The analysis indicates that load reductions of 33% to 82% are necessary in nonpoint source loads to the upper portions and tributaries of Jim Ford Creek. Load reductions based on chronic criteria were greater than those based on acute criteria, consequently the chronic analysis is the basis for the TMDL. A comparison of load reductions using the same procedures both with *E. coli* data instead of fecal coliform data yielded similar results in terms of estimated load reductions; however, the reductions based on the acute criteria were greater than those based on the chronic criteria for *E. coli*.

1.5 Ammonia

Ammonia can be both toxic to aquatic animal life and a source of nutrients to plants. Idaho water quality criteria for ammonia is based on ammonia toxicity and vary depending upon pH and temperature conditions. As pH and temperature increase, the toxic form of ammonia increases; thus, the criteria are more stringent under higher temperature and pH conditions.

Total ammonia levels taken at various locations in the Jim Ford Creek watershed were initially compared to a conservative target based on worst-case pH and temperature conditions. Only a small portion of these samples, 10 of 225, exceeded this conservative target. These 10 samples were then compared to the applicable criteria based on actual or estimated pH and temperatures. None of the ammonia levels in these 10 samples exceeded applicable criteria. Based on this evaluation, a TMDL for ammonia based on its toxicity effects was not needed. The nutrient effects of ammonia were considered in the nutrient TMDL.

1.6 Oil and Grease

Oil and grease is a general measure of pollution from petroleum compounds. Idaho water quality criteria indicate oil and grease concentrations must be less than levels which impair beneficial uses. It is unclear why oil and grease were identified on the §303(d) lists as pollutants of concern

for Jim Ford Creek. Limited sampling for oil and grease was conducted in 1998 at locations considered most likely to have oil and grease from stormwater runoff and also at locations considered representative of general creek conditions. All samples had no measurable level of oil and grease. Given these results and because a regulatory framework exists to address oil and grease problems which are readily identified and treated, no TMDL for oil and grease was developed.

1.7 Flow and Habitat

Flow and habitat are identified on the §303(d) list as impairing uses in Jim Ford and Grasshopper Creeks. The TMDL does not address flow and habitat issues because these parameters are not currently required to be addressed under §303(d) of the Clean Water Act.

1.8 TMDL Implementation Plan

Within 18 months of approval of this TMDL, Jim Ford Creek Watershed Advisory Group and supporting agencies will produce an implementation plan. This plan will specify projects and controls designed to improve Jim Ford Creek water quality by meeting the load allocations presented in this TMDL document. Implementation of best management practices within the watershed to reduce pollutant loading from nonpoint sources will be on a voluntary basis except when State regulatory agencies dictate best management practice implementation. Because no load reductions are required from point sources, all of required reductions will be addressed through the Watershed Restoration Strategy. This Watershed Restoration Strategy provides the framework for the implementation plan. It lists the types of best management practices the Jim Ford Creek Watershed Advisory Group believes will best improve water quality. Example practices include prescribed grazing, alternate livestock water supplies, livestock exclusions, animal waste systems, tree and shrub planting, grassed waterways, streambank stabilization, conservation cropping and tillage practices and protected riparian zones.

As additional information becomes available during the implementation of the TMDL, the targets, load capacity, and allocations may be revisited. In the event that new data or information shows that changes are warranted, TMDL revisions will be made with assistance of the Jim Ford Creek Watershed Advisory Group. Although specific targets and allocations are identified in the TMDL, the ultimate success of the TMDL is not whether these targets and allocations are met, but whether beneficial uses and water quality standards are achieved.

EXECUTIVE SUMMARY LOADING TABLE

Pollutant	Target	Subwatershed	Load	Load Capacity	Reduction Needed	
Fine Sediment	50 mg/L TSS monthly average and 80 mg/L instantaneous Turbidity not to exceed background by > 50 NTU instantaneous or by 25 NTU for more than 10 consecutive days	No load reduction required				
Coarse Sediment	Decrease bedload transport rate in transport reaches by about 95%	Bankfull width/depth ratio below 40 - 56% decrease				
		Increasing trend in residual pool volume - 49% increase				
Temperature	19°C/66°F daily average for the reaches above the falls 9°C/48°F daily average during salmonid spawning period for the reaches of Jim Ford Creek below the falls	Subwatershed	Frequently Occurring Temperature	Load Capacity	% Temp reduction	% Shade Increase
		Miles/Wilson	16°C/61°F	19°C/66°F	0%	0%
		Karniah	15°C/59°F	19°C/66°F	0%	0%
		Heywood	20°C/68°F	19°C/66°F	5%	14%
		Grasshopper	23°C/73°F	19°C/66°F	17%	52%
		Mainstem Jim Ford to confluence with Grasshopper	21°C/70°F	19°C/66°F	10%	40%
		Mainstem Jim Ford from Grasshopper confluence to waterfall	22°C/72°F	19°C/66°F	14%	50%
		Winter	15°C/59°F	9°C/48°F	40%	47%
		Lower Jim Ford below waterfall	13°C/55°F	9°C/48°F	31%	40%

Pollutant	Target	Subwatershed	Load	Load Capacity	Reduction Needed
Total Inorganic Nitrogen	25% MOS 0.225 mg/L during growing season of April through October	Miles/Wilson	95	595	0%
		Heywood	65	484	0%
		Upstream Weippe	261	1601	0%
		Grasshopper Creek	69	700	0%
		Downstream Weippe	647	1780	0%
		Winter Creek	51	483	0%
		Lower Jim Ford	1016	4289	0%
Total Phosphorus	25% MOS 0.075 mg/L during growing season of April through October	Miles/Wilson	267	198	26%
		Heywood	238	161	32%
		Upstream Weippe	793	534	33%
		Grasshopper Creek	244	233	5%
		Downstream Weippe	737	593	24%
		Winter Creek	113	161	0%
		Lower Jim Ford	2353	1801	26%
Bacteria	20% MOS in target Primary (May - Sept) 400 cfu/100 mL instantaneous and 40 cfu/100 mL 30-day geometric mean target	Miles/Wilson	5,990 bcfu/year	1,790 bcfu/year	70%
		Heywood	3,880 bcfu/year	1,460 bcfu/year	62%
		Upstream Weippe	4,710 bcfu/year	1,470 bcfu/year	69%
		Grasshopper Creek	1,270 bcfu/year	850 bcfu/year	33%
		Winter Creek	3,920 bcfu/year	1,480 bcfu/year	62%

cfu - colony forming units; bcfu - billion cfu/year; lbs - pounds; °C - degrees centigrade;
°F - degrees Fahrenheit; MOS - margin of safety; NTU - nephelometric turbidity unit

2.0 WATERSHED ASSESSMENT

2.1 Watershed Characterization

2.1.1 General Description

Jim Ford Creek is a third order tributary of the Clearwater River in the southern part of Clearwater County, Idaho. The creek flows twenty miles northwest, from an elevation of 4,068 feet to 1,050 feet, at its confluence with the Clearwater River near Orofino, Idaho (Figure 1). It drains a 65,838 acre watershed that has two distinct portions. In the upper portion, Jim Ford Creek flows through rolling forested uplands and the Weippe prairie until it reaches the City of Weippe. Below Weippe, the creek enters into a narrow steep basalt canyon nearly fourteen miles in length. A 65 foot waterfall at the top of the canyon restricts fish passage upstream. Primary land uses in the watershed consist of timber production, grazing, and recreation in the entire watershed; dryland agriculture on the rolling Weippe prairie; and a small urban area at the City of Weippe. A small hydropower facility is located along the creek just downstream of Weippe.

2.1.2 Climate

Climate in the Jim Ford Creek watershed is characterized by cool, moist winters and warm, dry summers. Rainfall patterns and air temperatures within a watershed of this size predominantly change according to elevation. The growing season also varies in the watershed according to elevation. The average consecutive frost free period ranges from around 158 days near the mouth, to 118 days on the Weippe prairie (CSWCD 1993).

Table 1 provides examples of average precipitation and air temperatures at sites near the Jim Ford Creek watershed. Precipitation and air temperature have been measured near but not within the Jim Ford Creek watershed at Orofino and Pierce, Idaho over a 30 year period.

These data indicate average annual precipitation increases about 8.6 inches per 1,000 feet rise and annual air temperature values drop an average of 3.7 °F per 1,000 feet rise within the Jim Ford Creek watershed.

Table 1. Average Annual Precipitation and Temperature, 1961-90

Site	Elevation (feet)	Precipitation (inches)	Temperature (°F)
Kamiah ¹	1,212	24	
Orofino ²	1,320	24	50
Pierce ²	3,188	42	43
Hemlock Butte ¹	5,810	70	

¹NRCS, 1998 ²NWS, 1998

Precipitation estimates for elevation zones within the Jim Ford Creek watershed using data at Orofino and Pierce indicate the average annual precipitation ranges from around 24 inches per year at the mouth to 42 inches per year at the eastern watershed boundary. Using this same approach, the average annual air temperature within the Jim Ford Creek watershed is estimated to range from 52°F at the mouth to 41°F at the eastern watershed boundary. Figures 2 - 4 show how the average monthly air temperature and monthly precipitation change over the course of the year.

These graphs support the observation that the Jim Ford Creek watershed experiences little precipitation during the warm summer months. An increase in precipitation is then seen during the cooler seasons of the year. Snow tends to accumulate in the upper portions of the watershed during the winter months and melt during the spring months. The upper ridges to the east tend to be snow free from mid-June until the end of October.

Citizen volunteers collected weather data at various locations in/near the Jim Ford Creek watershed. Table 2 provides a summary of relevant citizen monitoring weather data.

Table 2. 1998 Water Year Monthly Precipitation

Month and Year	Weippe Monthly Precipitation Recorded by Mick Jackson (inches)
Oct 1997	2.72
Nov 1997	2.13
Dec 1997	1.75
Jan 1998	2.36
Feb 1998	1.12
Mar 1998	2.42
April 1998	3.09
May 1998	5.21
June 1998	2.81
July 1998	1.39
Aug 1998	0.39
Sept 1998	2.27
Total	27.66 to date

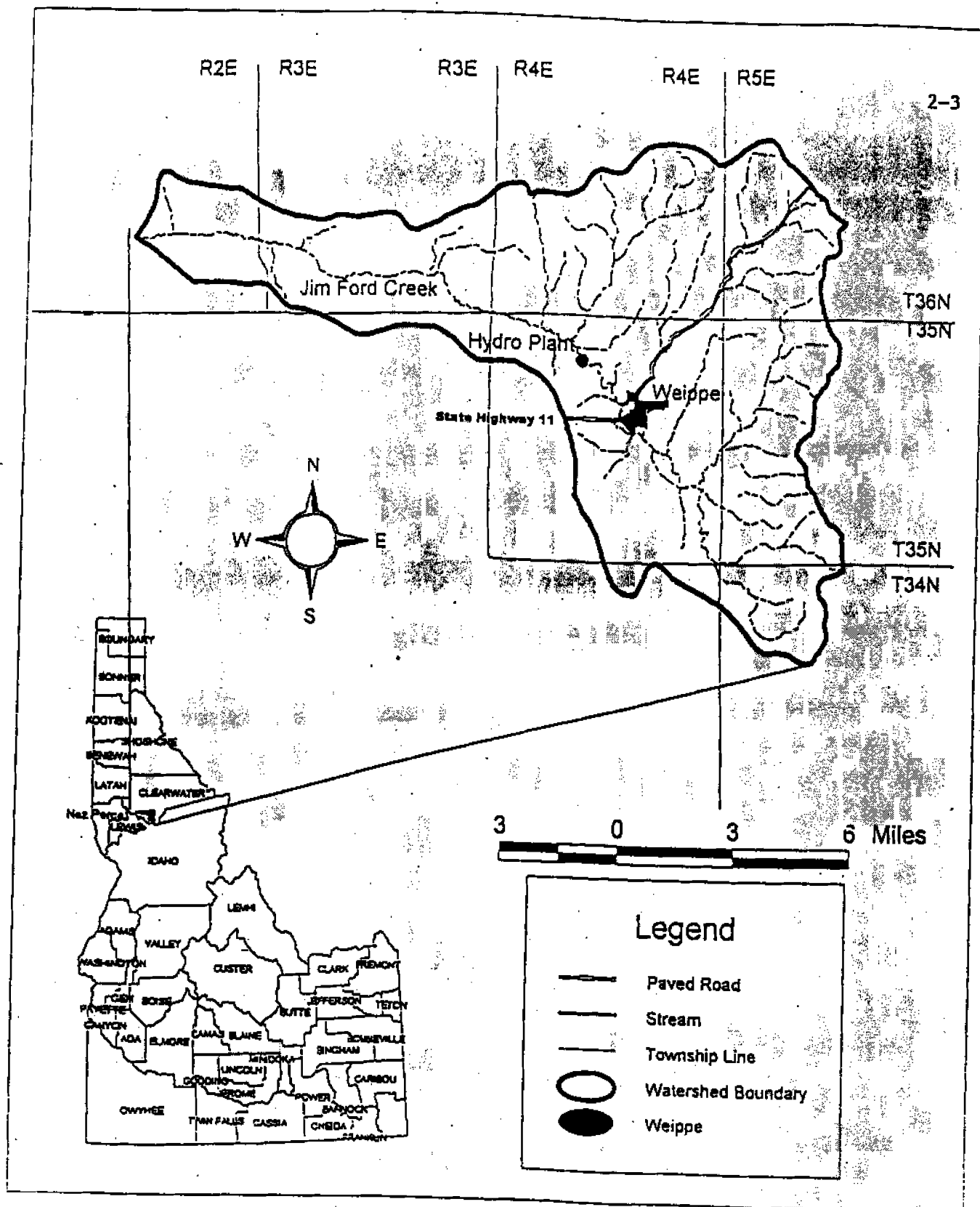


Figure 1. Location of the Jim Ford Creek Watershed, Idaho

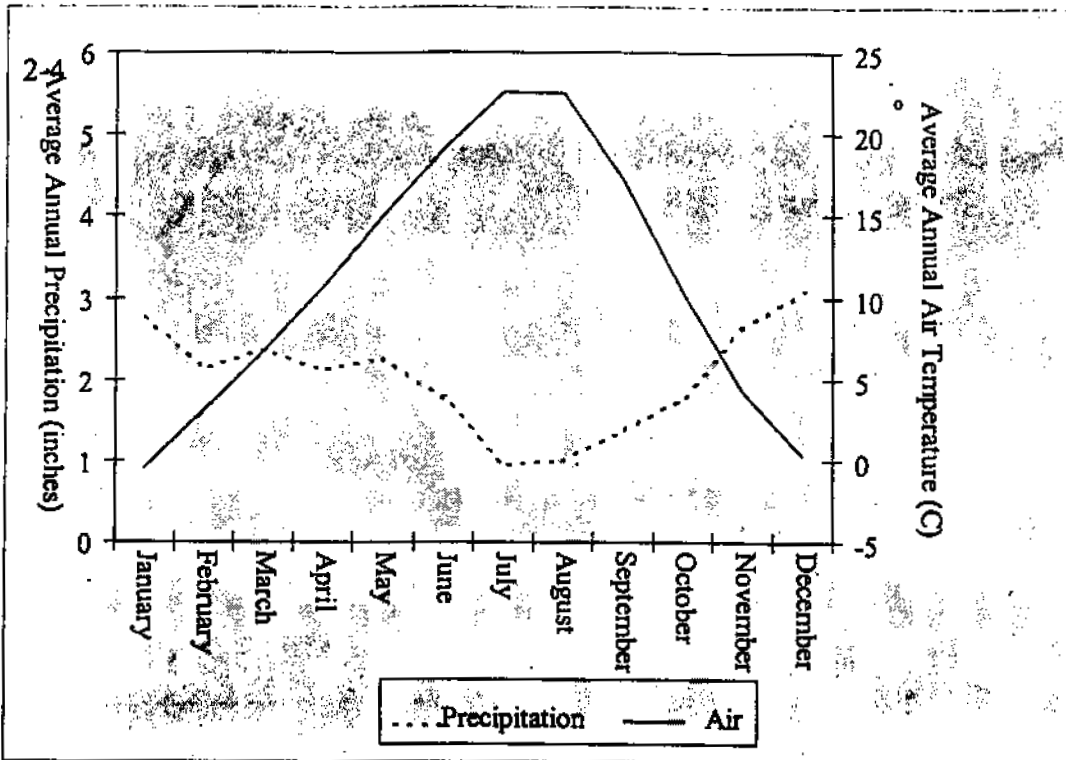


Figure 2: Monthly Average Air Temperature and Precipitation Estimated for the Mouth of Jim Ford Creek

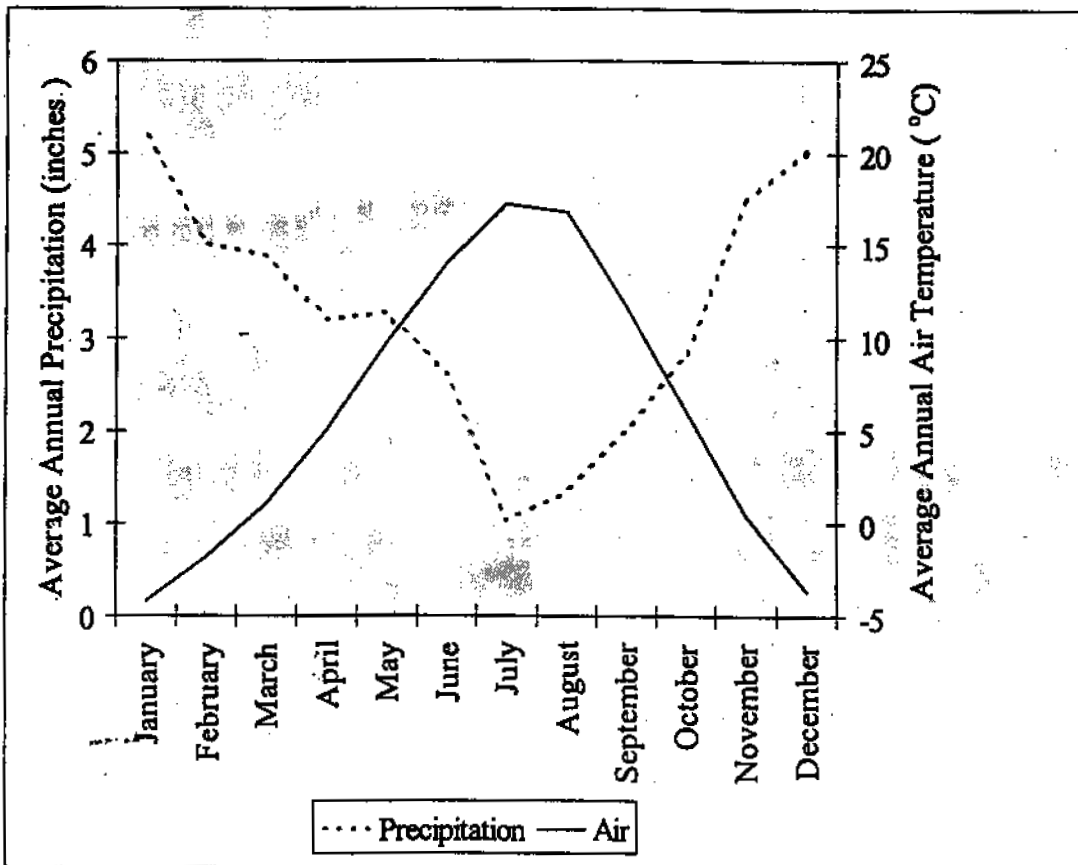


Figure 3: Monthly Average Air Temperature and Precipitation Estimated for the Town of Weippe

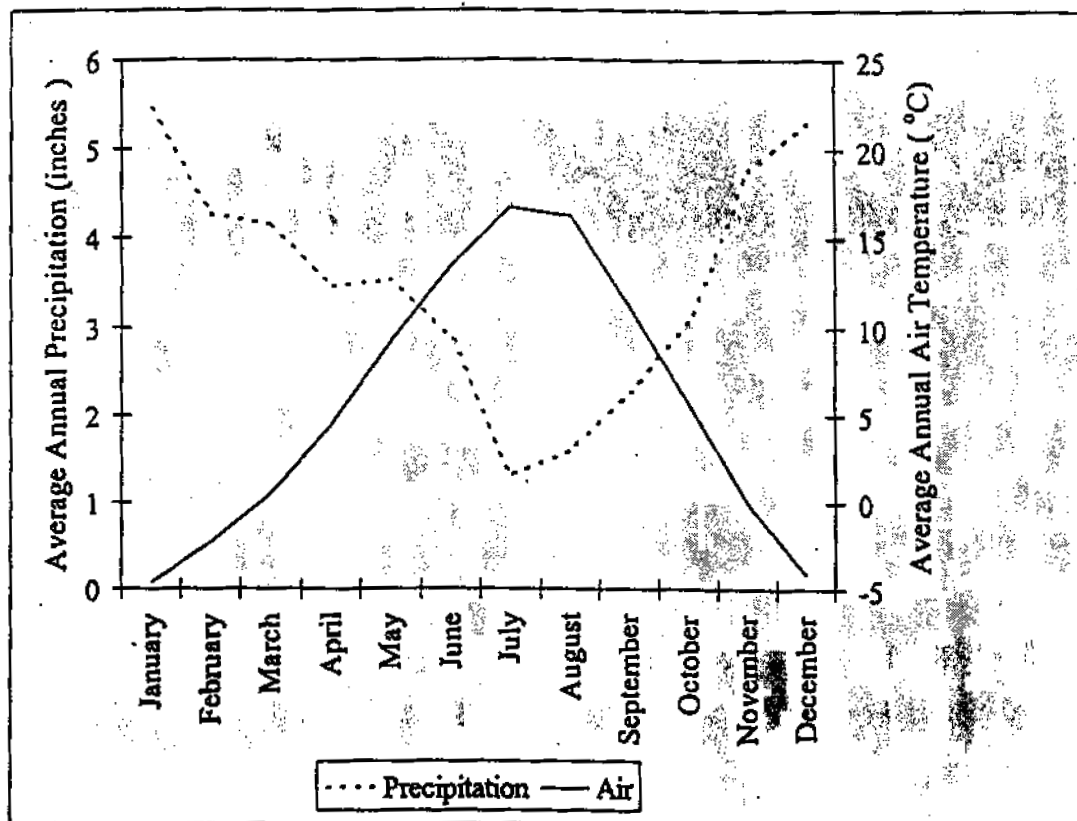


Figure 4: Monthly Average Air Temperature and Precipitation Estimated for the Eastern Portion of the Jim Ford Creek Watershed

2.1.3 Hydrology

The upper portion of Jim Ford Creek is formed where Miles and Heywood Creeks join (Figure 5). Jim Ford Creek then flows over the flat Weippe Prairie and through the City of Weippe. At the City of Weippe, Grasshopper Creek flows into Jim Ford Creek. The lower portion of Jim Ford Creek flows over a 65 foot waterfall and through a narrow, steep sided canyon nearly 14 miles in length. Tributaries to the lower portion of Jim Ford Creek include Winter and Shake Meadow Creeks. A 45 foot to 55 foot waterfall exists on Winter Creek approximate 3/4 mile from its confluence with Jim Ford Creek (T35N, R4E, Sec. 4 NE1/4NW1/4).

Jim Ford Creek is characterized by low flows of about 2 cubic feet per second (cfs) during the summer months and increasing flow of about 50 cfs during the fall and winter months until the peak flow season during April and May. Bankfull discharge is about 170 cfs. Jim Ford Creek is classified as perennial along its entire course (USGS 1963).

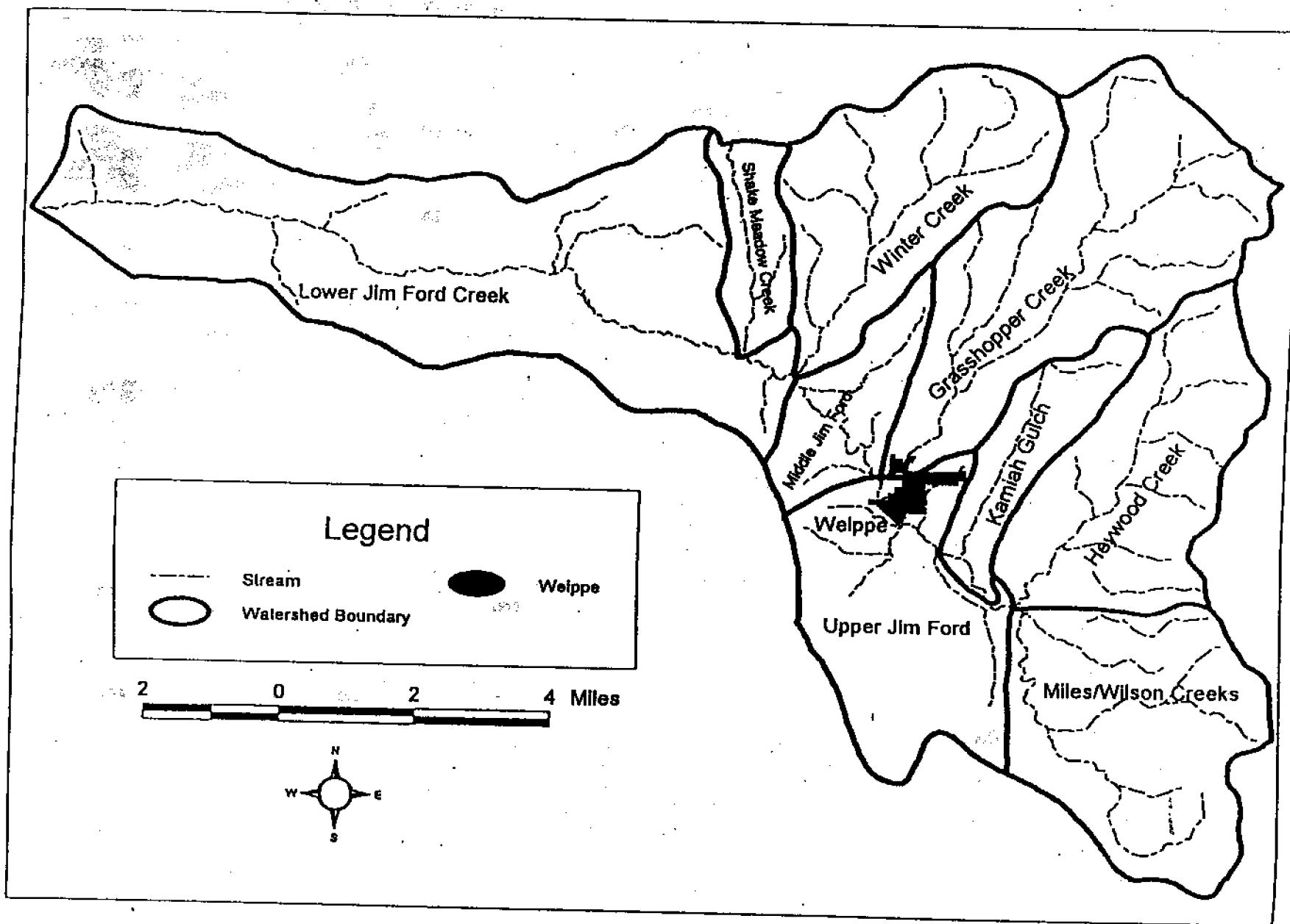


Figure 5: Jim Ford Creek Sixth Order Watersheds

Within the canyon portion, Jim Ford Creek downstream of Weippe, the stream gains water from several side springs and tributaries. Harvey (1990) estimated the annual mean maximum flow of 120 cfs at the City of Weippe and of 178 cfs at the point where Jim Ford Creek enters the Clearwater River. Harvey (1990) estimated annual mean minimum flows of 1 cfs at the City of Weippe and of 1.5 cfs at the mouth.

To better understand the hydrograph of Jim Ford Creek, the mean daily discharge for each month of the water year is estimated using US Geological Survey (USGS) regional regression equations (Kjelstrom 1998). The mean daily discharge for each month of eight subwatersheds is estimated using the USGS regional regression equations (Kjelstrom 1998). These subwatersheds include: 1) lower Jim Ford (including Shake Meadow); 2) Winter; 3) Grasshopper; 4) middle Jim Ford; 5) Miles/Wilson; 6) Heywood; 7) upper Jim Ford; and 8) Kamiah Gulch (Figure 6).

Mean monthly discharge estimates made by Lipscomb (1998) for lower Jim Ford, Grasshopper, and middle Jim Ford/Miles/Wilson subwatersheds are used to predict mean daily discharge for the 20th, 50th, and 80th percentiles of the 6 subwatersheds. Kjelstrom (1998) subdivides central Idaho into regions which produced the best coefficients of determination from regression analyses. According to his map, Jim Ford subwatersheds are in Region 4. The mean daily discharge of subwatersheds which are not included in the USGS report are estimated using the unit discharge method. These flows are calculated using the mean daily discharge per drainage area for each month. The results of this analysis are reported in Table 3.

To estimate the mean daily flow for each month of Jim Ford Creek proper, the flows from each subwatershed are summed. For example, mean daily discharge of lower Jim Ford at the confluence with the Clearwater River is cumulative sum of all the subwatersheds within the basin (Table 4).

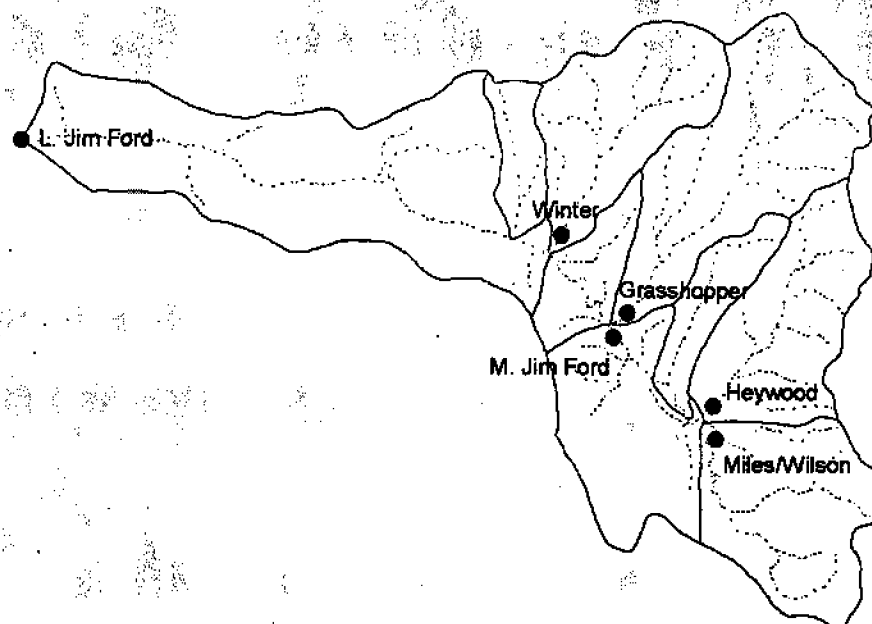


Figure 6. Flow Estimate Sites

Table 3. Estimated Mean Daily Monthly Discharge (cfs) for the 20th, 50th and 80th percentiles

Subwatershed	Watershed area (mi ²)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Ma	Jun	Jul	Aug	Sep
20th percentile													
L. Jim Ford	31	6.9	12.8	14.0	17.3	39.2	58.5	88.4	76.5	50.0	13.9	5.3	6.2
Winter	11	2.5	4.7	5.1	6.3	14.3	21.4	32.3	28.0	18.3	5.1	2.0	2.3
Grasshopper	17	3.7	6.7	7.2	9.0	20.2	31.7	46.7	39.9	27.0	7.2	2.8	3.1
M. Jim Ford	11	2.7	4.8	5.4	6.7	15.4	23.4	35.0	29.7	19.9	5.5	2.0	2.4
Miles/Wilson	13	3.1	5.5	6.2	7.6	17.6	26.7	40.0	33.9	22.7	6.3	2.3	2.7
Heywood	11	2.6	4.7	5.0	6.3	14.0	22.0	32.4	27.6	18.7	5.0	1.9	2.2
U. Jim Ford	4	0.9	1.7	1.9	2.3	5.3	7.9	11.9	10.3	6.7	1.9	0.7	0.8
Kamiah Gulch	4	0.9	1.7	1.8	2.3	5.1	8.1	11.9	10.1	6.9	1.8	0.7	0.8
50th percentile													
L. Jim Ford	31	4.3	6.9	7.0	8.4	20.4	36.0	53.3	52.9	29.6	7.8	3.9	4.5
Winter	11	1.6	2.5	2.5	3.1	7.5	13.2	19.5	19.3	10.8	2.8	1.4	1.6
Grasshopper	17	2.3	3.6	3.6	4.4	10.5	19.6	28.2	27.6	16.0	4.1	2.0	2.3
M. Jim Ford	11	1.7	2.6	2.7	3.3	8.0	14.4	21.1	20.5	11.8	3.1	1.5	1.7
Miles/Wilson	13	1.9	3.0	3.1	3.7	9.2	16.4	24.1	23.4	13.5	3.5	1.7	1.9
Heywood	11	1.6	2.5	2.5	3.1	7.3	13.5	19.5	19.1	11.1	2.8	1.4	1.6
U. Jim Ford	4	0.6	0.9	0.9	1.1	2.8	4.9	7.2	7.1	4.0	1.1	0.5	0.6
Kamiah Gulch	4	0.6	0.9	0.9	1.1	2.7	5.0	7.2	7.0	4.1	1.0	0.5	0.6
80th percentile													
L. Jim Ford	31	2.9	4.4	4.4	5.5	12.0	21.6	33.3	36.8	16.7	4.8	3.0	3.4
Winter	11	1.1	1.6	1.6	2.0	4.4	7.9	12.2	13.5	6.1	1.8	1.1	1.3
Grasshopper	17	1.5	2.3	2.2	2.9	6.2	11.7	17.6	19.2	9.0	2.5	1.5	1.7
M. Jim Ford	11	1.1	1.7	1.7	2.1	4.7	8.6	13.2	14.3	6.6	1.9	1.1	1.3
Miles/Wilson	13	1.3	1.9	1.9	2.4	5.4	9.9	15.1	16.3	7.6	2.2	1.3	1.5
Heywood	11	1.1	1.6	1.6	2.0	4.3	8.1	12.2	13.3	6.2	1.7	1.1	1.2
U. Jim Ford	4	0.4	0.6	0.6	0.7	1.6	2.9	4.5	5.0	2.2	0.6	0.4	0.5
Kamiah Gulch	4	0.4	0.6	0.6	0.7	1.6	3.0	4.5	4.9	2.3	0.6	0.4	0.4

Table 4. Cumulative Estimated Mean Daily Monthly Discharge (cfs)
for the 20th, 50th, and 80th Percentiles

Subwatershed	Cumulative Watershed area (mi ²)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
20th percentile													
L. Jim Ford	103	22.5	41.0	44.7	55.5	126.1	191.5	286.8	245.9	163.3	44.8	17.0	19.7
U. Jim Ford	40	9.3	16.8	18.5	22.9	52.3	79.9	119.3	101.5	68.1	18.6	7.0	8.1
M. Jim Ford	35	8.4	15.0	16.6	20.5	47.0	72.0	107.4	91.2	61.3	16.8	6.3	7.2
50th percentile													
L. Jim Ford	103	13.8	22.0	22.3	27.1	65.7	118.0	172.8	170.1	96.9	25.2	12.4	14.2
U. Jim Ford	40	5.7	9.0	9.2	11.2	27.3	49.2	71.9	70.2	40.4	10.5	5.1	5.8
M. Jim Ford	35	5.2	8.1	8.3	10.1	24.5	44.4	64.7	63.1	36.4	9.4	4.6	5.2
80th percentile													
L. Jim Ford	103	9.4	14.0	14.0	17.6	38.5	70.8	108.0	118.3	54.4	15.5	9.5	10.9
U. Jim Ford	40	3.9	5.7	5.8	7.2	16.0	29.5	44.9	48.8	22.7	6.4	3.9	4.5
M. Jim Ford	35	3.5	5.1	5.2	6.5	14.4	26.6	40.5	43.9	20.4	5.8	3.5	4.0

2.1.4 Geology

Jim Ford Creek watershed is located in the Columbia Plateau and Northern Rocky Mountains Geomorphic Provinces. Bedrock predominantly consists of Tertiary Age Columbia Basalt in the western portion of the watershed (near the mouth), and flat Cretaceous Age granitic rock of the Idaho Batholith in the eastern portion of the watershed (CSWCD 1993). Figure 7 provides a map of the general geology.

The oldest formations within this area are the granitic rock of the Idaho Batholith. This "basement" material is found in deeply eroded canyons and in the mountainous ridge east of Weippe (Ralston et al. 1978). Starting about 40 million years ago, successive flows of basaltic lava originating in Oregon and Washington began to spread into the area, filling major valleys, and extending up tributaries. Dams of basalt periodically formed, causing lakes to form near the outer margins. The fine grain sediments deposited in these lakes were then buried by later lava flows. The canyon portions of the watershed are characterized by basalt rock outcrops and colluvial slopes with various thickness of soils.

Jim Ford - Grasshopper Watersheds Geology

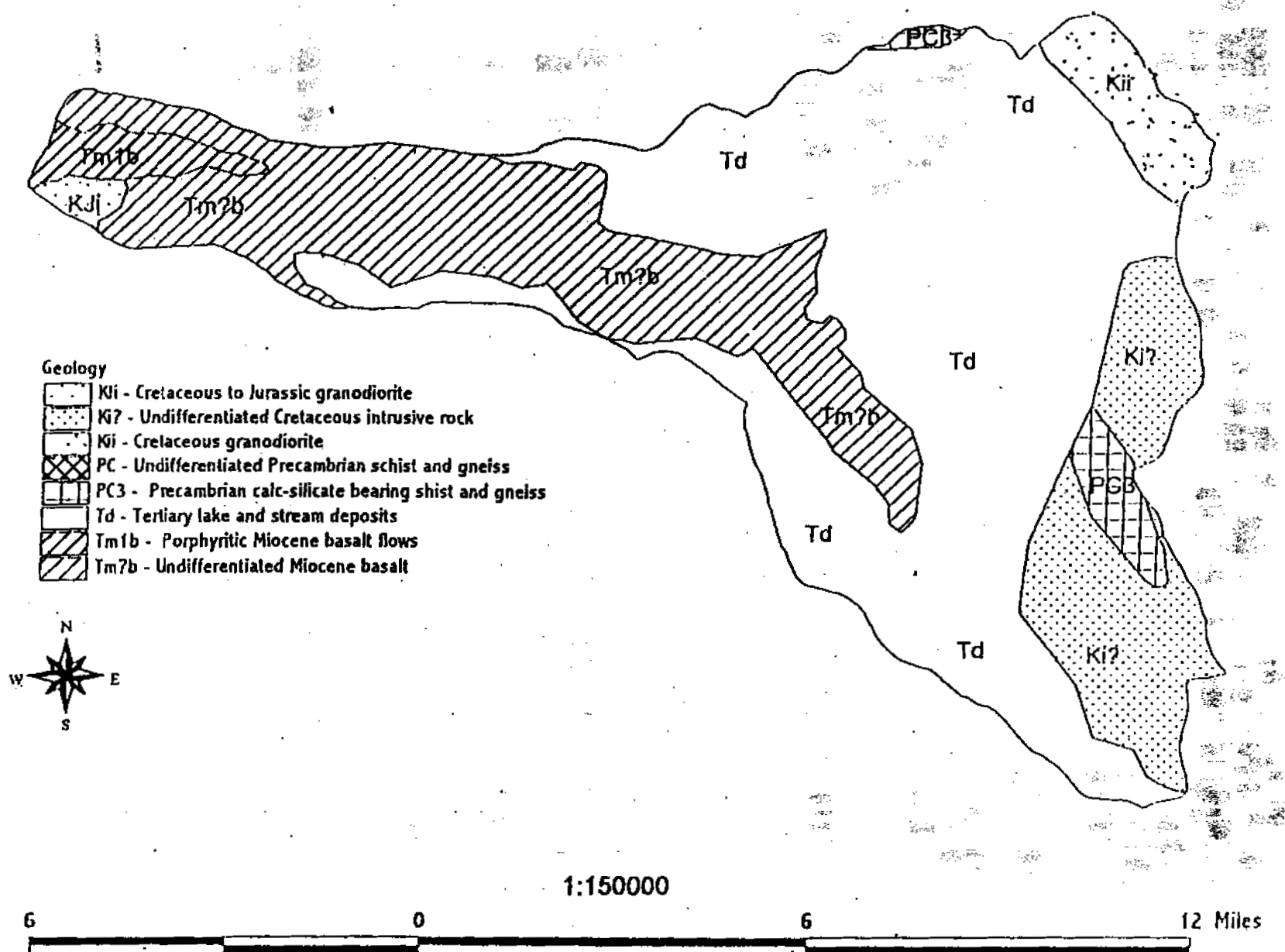


Figure 7. Jim Ford Creek Geology

The geology around the Weippe Prairie consists of a granitic basement, overlain by tertiary age Columbia basalt (Figure 7). The surface deposits of the Weippe Prairie and its immediate area are characterized by wind-carried and lake sediment deposits. The very flat prairie surface represents long-term deposition of fine grained material in a lake formed on top of successive flat-lying basalt. Most of the gentle plateau top terrain and some of the eastern hills have surficial layers of loess and volcanic ash. The rolling hills of Palouse Loess were deposited as dune-like ridges when prevailing winds dropped fine-grained material. These formations are located northeast of the City of Weippe.

A fault identified by Bond (1963) with a northwest-southeast orientation is located just west of the City of Weippe. It has a maximum vertical displacement in the tens of feet in the central portion, tapering to insignificance at either end. The faulting is thought to be a result of basalt settling under the massive weight of successive flows. The lower Jim Ford Canyon and the 65 foot waterfall are likely formed as a result of this fault.

The lower canyon of Jim Ford Creek is deeply incised into Columbia River Basalt. The modern morphology and bedload characteristics of this section of stream are strongly influenced by the lithology and shape of this canyon. This lower canyon is the major source of coarse bed-material transported to the Clearwater River. Field work performed as part of this TMDL identified small intrusions of metamorphic rock in the lower canyon. This material is mainly schist and is not shown on the geology map (Figure 7).

2.1.5 Soils and Soil Erosion Potential

Water quality concerns relating to soils are sedimentation caused by soil erosion and nutrient contamination from leaching and sedimentation. Soils within the Jim Ford Creek watershed have a nominal to intermediate potential for nutrient loss due to leaching and surface runoff. Soils found in the canyon and ridge areas have a moderate to very severe hazard potential for soil erosion by water. Many tributaries to Jim Ford Creek are at risk due to this soil erosion hazard.

The hazard of erosion (both surface and mass failure) is largely a function of parent material and slope steepness. The subsurface hydrology comes into play with mass failures.

On the canyon sides, north aspects are more likely to have more volcanic ash than south aspects and consequently will have a lower erosion potential. If there is no ash present, erosion potential of the soils are the same and then vegetative differences come into play. Both aspects on the canyon sides are generally more erosive due to slope than compared to the plateau.

On the plateau, most of the uplands on the plateau have ash over loess on relatively flat slopes (low to moderate erosion here). Ash cap thickness is greatest in the eastern portions of the plateau (4 inches to 12 inches). Land use that disturbs or mixes the ash and loess (farming, timber harvest or road construction) raises the erosion potential.

For riparian areas, a few small floodplains and higher terraces exist on the canyon floors. These are formed of stream alluvium and flood deposits and tend to contain much sand and stream gravels. Erosion hazard is low to moderate due to low slope. On the plateau, riparian areas tend to be broad flats and valley floors with poor drainage. They tend to be high in silt and clay and often have fragipans with perched water in the winter and spring months. Erosion hazard is generally low due to low slope. These soils have the greatest potential for nutrient movement to surface water.

Mountains at the north and east margin of the plateau (Brown Creek Ridge and ridges south of Orofino Creek Point) mostly have ash over loess or ash over residuum from granitic rock. Slopes are not that steep (relatively) and erosion on areas with a good ash cap is low to moderate. Land use is the biggest factor that will affect erosion potential.

On all landforms, roads that are cut through the ash and expose the subsoil will have a moderate to high erosion potential.

General soil type distribution is shown in Figure 8. The primary soil types within the canyon portion of the watershed are formed in colluvium, residuum, and slope alluvium from basalt rock, with an addition of loess and an ash mantle in areas. Within the Weippe Prairie soils are generally deep and somewhat poorly drained alluvial soils. Soils found within the eastern portion of the Jim Ford Creek watershed are formed in colluvium, residuum, and slope alluvium from granitic rock. Along the northern and southern ridge boundaries of the watershed, gently sloping plateaus and uplands are formed in residuum and loess with ash mantle in areas.

2.1.6 Fisheries

Jim Ford Creek has cold water biota as a designated beneficial use (Idaho Administrative Procedures Act (IDAPA) 16.01.02). The 65 foot waterfall at the top of the canyon portion at about stream mile 14 provides a full barrier to fish migration into the upper portions of the watershed. A 45 to 55 foot waterfall on Winter Creek about 3/4 mile upstream of its confluence with Jim Ford Creek also is a barrier to fish migration. Documented fish occurrences recorded by a variety of sources are provided in Tables 5a and 5b and a general description of these fishes are provided in this section. Although salmonid spawning is not a designated beneficial use for Jim Ford Creek, since salmonids have been documented below the falls, this existing beneficial use will be considered in the TMDL for lower Jim Ford Creek.

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Jim Ford - Grasshopper Watersheds

General Soils Groups

Figure 8

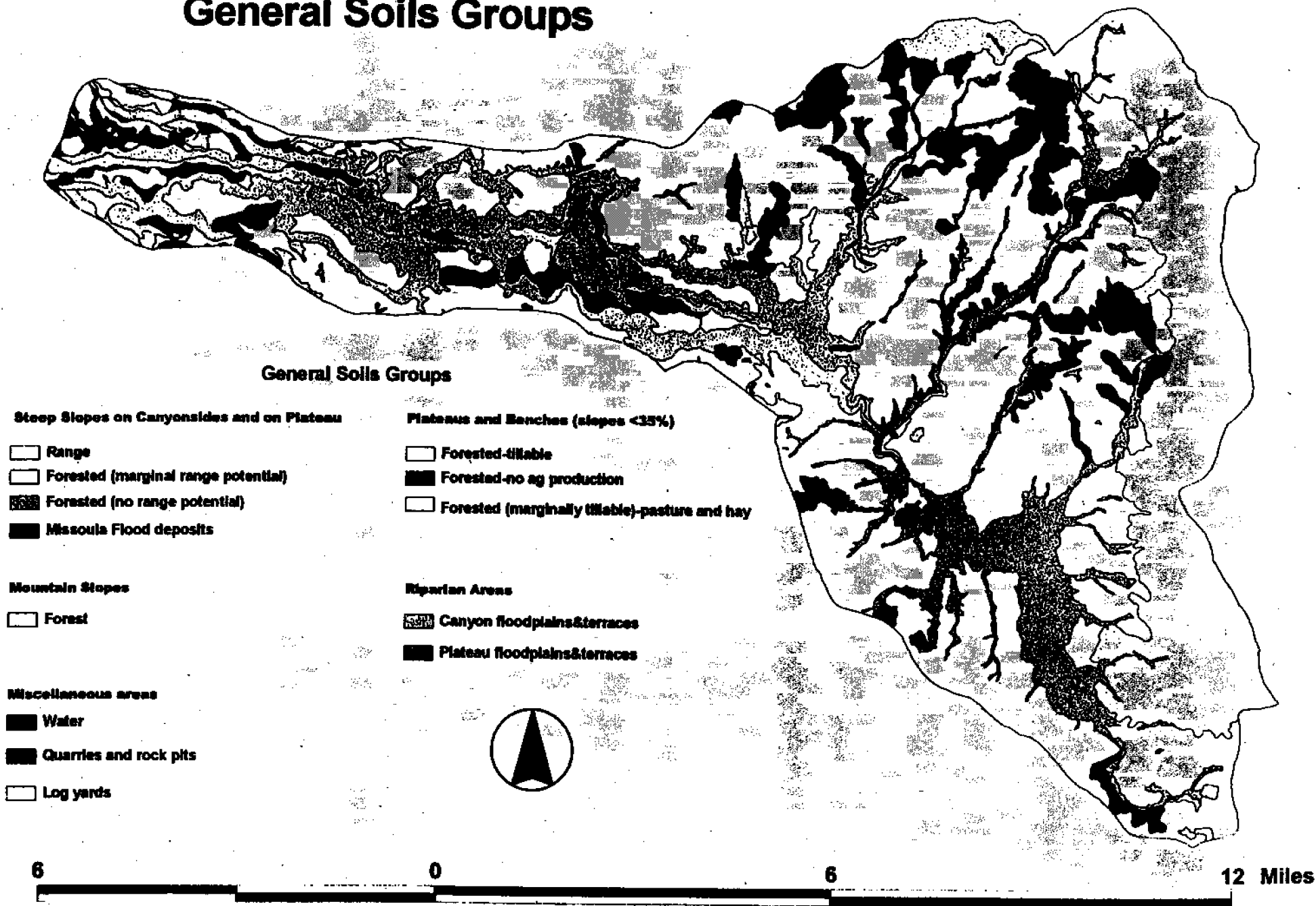


Table 5a. Documented Fish Species on Jim Ford Creek Below Waterfall
(IDEQ 1995, 1997, and 1998; Hoffman 1992; and Kucera 1984)

Common Name	Taxonomic Name
Chinook salmon	<i>Oncorhynchus tshawytscha</i>
Steelhead trout	<i>Oncorhynchus mykiss</i>
Resident rainbow trout	<i>Oncorhynchus mykiss</i>
Northern squawfish	<i>Ptychocheilus oregonensis</i>
Chiselmouth	<i>Acrocheilus alutaceus</i>
Bridgelip sucker	<i>Catostomus columbianus</i>
Sculpin	<i>Cottus sp.</i>
Smallmouth bass	<i>Micropterus dolomieu</i>
Speckled dace	<i>Rhinichthys osculus</i>

Table 5b. Documented Fish Species on Jim Ford Creek and Its Tributaries Above Waterfall (IDEQ 1995, 1997, 1998 and Steadman 1999)

Common Name	Taxonomic Name
Black bullhead	<i>Ictalurus melas</i>
Redside shiner	<i>Richardsonius balteatus</i>
Pumpkinseed	<i>Lepomis gibbosus</i>
Speckled dace	<i>Rhinichthys osculus</i>

Other fish species found in neighboring watersheds and throughout the Clearwater Basin which may have historically inhabited Jim Ford Creek include: pacific lamprey (*Lampetra tridentata*); westslope cutthroat trout (*Oncorhynchus clarkii*); and bull trout (*Salvelinus confluentus*). Pacific lamprey occur in areas accessible to salmon and steelhead and have been found in Lolo Creek (Kucera et al. 1983). Westslope cutthroat trout, listed as a sensitive species and proposed for listing under the Endangered Species Act (ESA) by US Fish and Wildlife Service (USFWS), are found in the upper Potlatch River, Orofino Creek, and Lolo Creek (Clearwater Subbasin Ecosystem Analysis 1997). Columbia River bull trout, listed as "threatened" by the ESA in 1998, have been observed in Orofino Creek, Jim Brown Creek, and Lolo Creek (Clearwater Bull Trout Technical advisory Team 1998). The Jim Ford Creek watershed has been identified by the Clearwater Bull Trout Advisory Team (1998) as one where bull trout habitat protection and enhancement should be emphasized.

2.1.6.1 Description of Documented Salmonid Fishes (from South Fork Clearwater Landscape Assessment USFS 1998)

Fall chinook salmon are listed as endangered in the Clearwater subbasin under the ESA of 1973. Critical habitat (National Marine Fisheries Service) for fall chinook salmon in the Clearwater River extends from the mouth of the Clearwater River at Lewiston, Idaho, upstream to the mouth of Lolo Creek at the Idaho County boundary. Fall chinook may use tributaries to the Clearwater for cold water refuge as juveniles; however, spawning is restricted to the mainstem Clearwater.

Snake River chinook salmon (fall, spring, and summer) were listed as threatened under the ESA in 1992. Spring chinook salmon in the Clearwater River were exempted from the listing because of uncertainty associated with the genetic integrity of this stock. Genetic integrity was questioned because the construction of the Lewiston Dam in the early 1900's allegedly eliminated all runs of native spring chinook salmon in the Clearwater Basin. Those currently found in the basin are exclusively of hatchery origin although they may be naturally reproducing. Spring chinook start spawning in mid-August and summer chinook start spawning a little later. Differentiation between spring and summer chinook has not occurred in the Jim Ford watershed (Cochenauer 1999).

National Marine Fisheries Service (NMFS) listed the Snake River steelhead as threatened under the 1973 ESA in 1997. The viability of wild and naturally spawning steelhead in the Clearwater Basin is a concern. Decline in population is due to the interrelationship of many factors at the Columbia River basin level. Adult steelhead begin migrating up the Columbia River in July and August and usually arrive at the Clearwater River in September. They remain in the large pools of the mainstem Clearwater River throughout the winter months, and move to tributaries during the spring to spawn. Fry emerge in June-July and juveniles rear for two to three years in freshwater before migrating to the ocean.

Jim Ford Creek's rainbow-steelhead density of $0.02/\text{m}^2$ (Kucera 1984) was the lowest of 10 Nez Perce Tribe (NPT) reservation tributaries to the Clearwater River sampled in the 1983-84 study (values ranged from 0.02 - $0.22/\text{m}^2$). Recent NPT electrofishing (1998) found a density of $0.01/\text{m}^2$ and at least 2 age classes of rainbow/steelhead. Chinook densities were $0.005/\text{m}^2$ (NPT 1998) and 80-110 mm in length (age 0). Steelhead and chinook in Jim Ford Creek may be considered wild/natural, as no stocking has occurred in this watershed (Roseberg 1999; Cochneauer 1999; and Kucera 1999).

2.1.6.2 Description of Other Documented Fish Species (Simpson and Wallace 1982)

Squawfish prefer to spawn in shallow water over a gravelly bottom in late May to early July and eggs are deposited at random. Squawfish eat aquatic invertebrates, but fish are the bulk of their diet.

The sculpin has been used as an indicator of waters of high quality having high oxygen, cool temperatures, and low levels of pollution. Generally sculpin spawn in May and early June with adhesive eggs deposited in rock crevices and under rocks. The nest usually is protected by a single male until the eggs hatch after 30 days at 50° F. Sculpin eat insects and small fish and serve as an important food source for trout.

Chiselmouth spawning occurs in spring and early summer in water temperatures that reach 60°F. Spawning occurs in streams over gravel or small rubble. Adults feed exclusively on algae although the young will feed on the surface and consume insects.

Bridgelip suckers prefer colder water of small, fast flowing rivers with gravel to rocky bottom. Spawning takes place in late May-June.

Smallmouth bass prefer cool water of streams with extensive riffle areas and clean gravel or rubble bottoms or lakes with rock ledges or outcroppings. Spawning occur when water temperatures reach 60 to 65°F. Food consists of aquatic and terrestrial insects, crayfish, and small fish.

The black bullhead has a high tolerance for silty water, low oxygen, and warm water temperatures of 75 to 85° F. Spring spawning occurs when water temperatures reach 65° F. Food consists of snails, aquatic insects, crustaceans, and plant material. The black bullhead is not a native species of Idaho.

Speckled dace will live in a variety of habitats, but normally prefer shallow, cool and quiet waters. Little is known of the spawning habits of this fish in Idaho, except that it spawns in the spring. Stomach analysis indicate that it is an omnivorous feeder.

The redbside shiner prefers lakes, ponds, or a river with slow-moving currents. Spawning occurs in June or July with adults moving into spawning areas when the water temperatures reaches at least 50° F. The eggs are adhesive when broadcast by the female. Eggs settle to the bottom and become attached to the substrate or submerged vegetation. Fry feed on small planktonic organisms but switch to a diet of insects, mostly terrestrial, by the second year of life. They will also eat eggs, often their own.

Pumpkinseeds reproduce in the spring when water temperatures reach approximately 65° F. Nests are built in on the bottom in fine gravel or sand. These fish eat mainly snails and aquatic insects although small fish, larval frogs and salamanders may also be eaten.

2.1.7 Historical and Present Day Land Uses

2.1.7.1 Historical Land Use (Bonner and Steadman 1999)

The Weippe Prairie and surrounding areas on Grasshopper Creek, Wilson Creek and Heywood Creek have been utilized by the NPT since time immemorial. This utilization included subsistence gathering activities such as camas digging. The Nez Perce referred to Jim Ford Creek as "Ty-oh-wah" (Shawley 1984).

The following is a description of the Weippe prairie provided by Sergeant John Ordway of the Lewis and Clark Expedition on June 10th, 1805 (Moulton 1997):

"this level consists of about 2000 ackers of level Smooth prarie on which is not a tree or Shreub, but the lowest parts are covred with commass which is now all in blossom, but is not good untill the Stalk is dead, then the natives assemble and collect their winters food in a short time as it is verry convenient for their villages as points of timber runs out in the praries of higher ground & covred with pitch pine. a fine timbred country all around this rich land the Soil is deep black & verry rich & easy for cultivation..."

Some grazing and cutting hay on the meadows probably began in the 1860's, soon after gold was discovered in the Pierce and Musselshell area. Land clearing in the Jim Ford and Grasshopper Creek watersheds probably started in the late 1800's. Most of the land in the Jim Ford and Grasshopper Creek area was cleared from 1900 to approximately the 1950's. Most of the land was cleared for grazing and raising hay. There was a small amount of grain (mostly oats) planted. The growing season was too short for wheat and barley varieties of the time.

Timber harvesting started in the early 1920's. There were several small logging operators that cut logs for lumber and several large pole operations in the Jim Ford Creek drainage. Logging increased from the 1950's to 1980's. Logging still continues in the Jim Ford drainage.

Sometime in the late 1920's, a lumber mill in Weippe created an impoundment to store cut logs during the winter by damming Jim Ford Creek near the existing location of the Jim Ford Creek hydroplant downgradient of the confluence with Grasshopper Creek. This impoundment covered approximately 13-15 acres and backed up waters to areas further south and east of Weippe. It is believed that this impoundment lead to sediment accumulation in the prairie portions of Weippe where flow was slackened, and is estimated to have affected the lower portions of Grasshopper Creek in the vicinity of the City of Weippe and portions of Jim Ford Creek about a mile south and east of the impoundment. It has been generally observed that runoff flows are of higher magnitude but shorter duration than flows preceding major land management activities in the Jim Ford Creek watershed (Bonner 1999).

2.1.7.2 Present Day Land Use

Table 6 provides a land use summary by watershed, which are shown in Figure 9. Forestry land uses are the dominant feature in the Jim Ford Creek watershed (87%). Forestry land uses include timber harvest, road construction and maintenance, and grazing. Other land uses include pasture and rangeland (12%) and non-irrigated cropland (1%). Non-irrigated agricultural activity is centered in the Weippe Prairie area. Cattle grazing occurs throughout much of the watershed.

Table 6. Land Use by Subwatershed

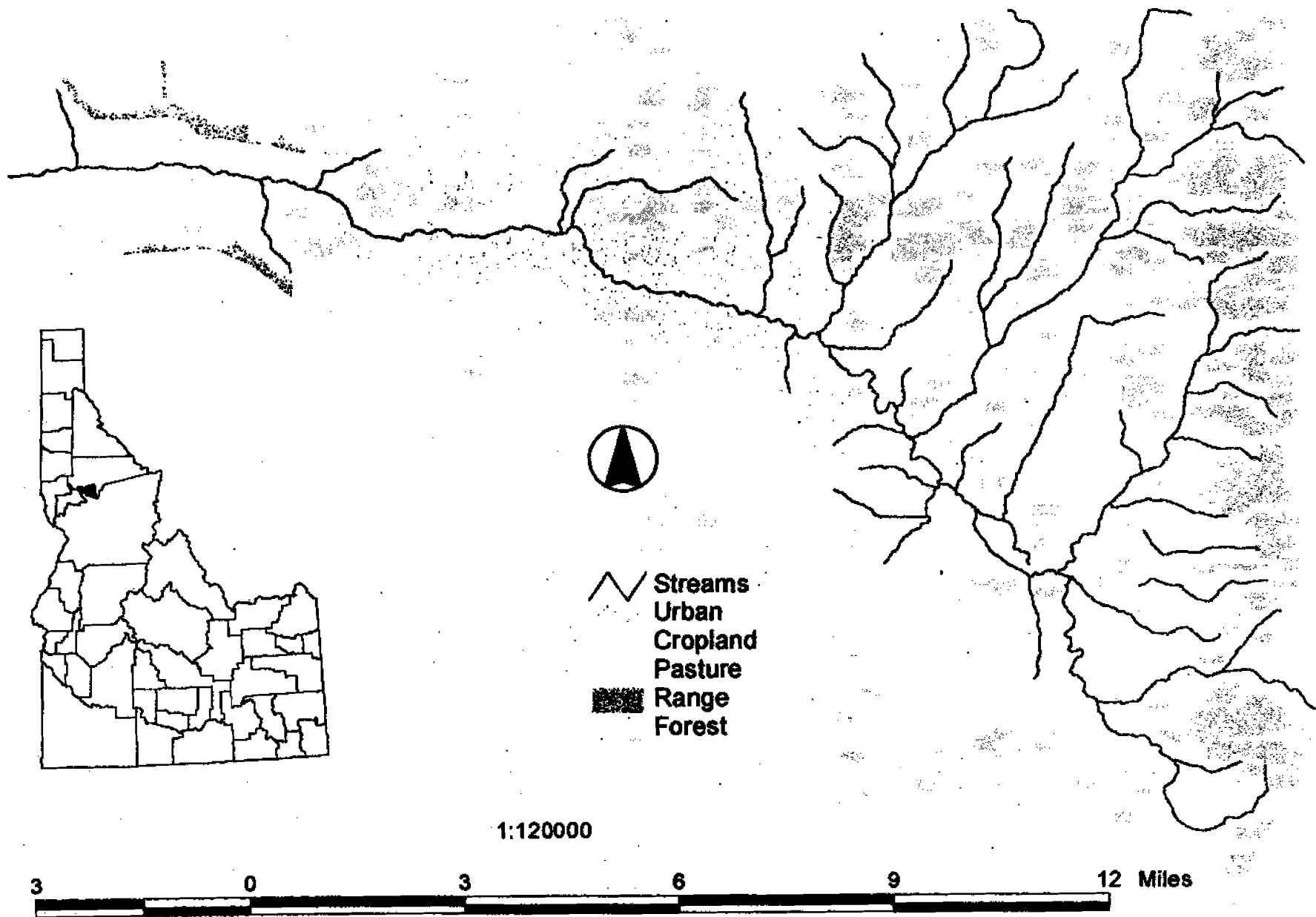
Land use	Lower Jim Ford	Upper Jim Ford	Winter	Grasshopper	Heywood	Miles & Wilson	Total and percentage
Urban		364		117			481 - <1%
Cropland	1,116						1,116 - 2%
Pastureland	1,132	3,888	346	1,640	1,244	288	8,538 - 14%
Rangeland	664						664 - 1%
Forestland	17,024	8,278	6,936	8,829	6,093	7,879	55,039 - 83%
Total	19,936	12,530	7,282	10,586	7,337	8,167	65,838

Cropland: Cropland in the Jim Ford Creek drainage (1% of the land use) is located on loess covered basalt plateau soils that were cleared of timber for agricultural production. Soil profiles range from moderately deep and moderately well drained on 3 to 20% slopes. Perched water tables are present at 18-36 inches from February to May. Due to the slow and very low permeability, these soils have a medium to rapid runoff potential. Topography varies with slopes ranging from nearly level to 15%. Average annual precipitation is 28 inches, and all cropland is non-irrigated. Traditional crops produced in this watershed are wheat, barley, winter peas, hay, and pasture, with occasional crops of spring canola or lentils. No-till farming has increased from 5% in 1990 to 85% currently. This system of planting has greatly reduced the potential for surface erosion through the critical erosion period of November through March. Under a conventional tillage system, seedbed preparation for fall planting renders these erosive forest soils unprotected during the critical erosion period.

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Jim Ford - Grasshopper Creek Watersheds Landuses

Figure 9



Pasture and Hayland: 14% of the land use (9,217 acres) within the watershed is non-irrigated pasture and hayland. Approximately 80% of the pasture acres are located in the Weippe-Prairie area on bottomland soils with slopes of 0 to 4%. Grass-legume and alfalfa hay are also produced on these soils. The remaining 20% of pastureland acres occur on soils of moderately steep slopes, up to 15%. Pasture and hayland acres in the watershed are often located in close proximity to perennial streams and intermittent drainages. Since pastures often lie adjacent to riparian areas, livestock grazing use of pastures can have a direct influence on the character of the stream zone. Larger cattle operations in the watershed generally utilize the surrounding state forestlands. On smaller family ranching operations, grazing may take place year round on private pasturelands. Existing forage vegetation in the pasturelands is typically in fair to poor condition due to heavy grazing pressure, poor fertility management, and the subsequent invasion of weeds.

Rangeland: There are approximately 664 acres of rangeland within the watershed, which represents about 1% of the total land base in the Jim Ford Creek drainage. Most of the rangeland occurs on steep canyon walls adjacent to perennial streams on south facing aspects of 40 to 90% slopes. A small portion of the rangeland occurs on more gently sloping soils adjacent to the canyon rims. Range condition is fair to poor in most of the watershed, with the plant communities being composed of less than 25% native plant species. Continuous livestock grazing pressure over many decades has resulted in deteriorated range condition, with present vegetation predominantly annual grasses and other exotic species.

Forestland: Forestland ownership is divided between Potlatch Corporation, the State of Idaho, and non-industrial private land and makes up over 80% of the total land base (55,039 acres) in the watershed. The State of Idaho and private industrial land is actively managed for timber production. Non-industrial private forestland is mostly grazed by livestock, and intermittently managed for timber production. The intensity and quality of forest management follows, and is related to the level of professional forestry assistance used. On private industrial, non-industrial private, and state land, best management practices are dictated by landowner policy, tribal policy, and by State law.

The NPT Forestry Division manages 1,601 acres of tribal and allotted forest lands within the watershed. Land management policy on tribal land is prescribed by the Code of Federal Regulations.

Soils in the forested areas are found on several different landforms with a mixture of parent materials. Both the depth and permeability vary widely. The depths range from moderately deep to very deep, and are poorly drained to well drained. Overall permeability is moderate. Slopes range from 0 to 4% on the valley floors to 35% on the gently sloping to steep upland plains, benches and plateaus and then up to 90% in some areas of the canyon. Average annual precipitation ranges from 28 to 35 inches. Topography within the watershed changes dramatically in the downstream direction. The predominant use is timber production, wildlife habitat, and recreation, with varied amounts of livestock grazing relative to the steepness of the slopes.

Stands in the canyon are dominated by Douglas-fir on the north aspect and ponderosa pine and Douglas-fir on the south aspect. The past occurrence of wildfire in the canyon is apparent by the stand composition and age of the canyon forests. Western red cedar and grand fir dominate along the stream bottoms where more moisture is available, and fire probably burned less intensely. The upper watershed is dominated by diseased stands of grand fir on the flats above the prairie where fire suppression and historical logging have favored climax species over seral species such as ponderosa pine, Douglas-fir and western larch. The seral species are a higher component of the forest stands in the higher elevations of the upper watershed, along with grand fir and cedar on the moister and more productive sites. A diversity of age classes are represented in the forest stands of the watershed, partly due to natural processes such as wildfire, and partly due to management.

Urban: The small urban community of Weippe is the main population center in the watershed. Weippe presently has a population of approximately 500 residents. The Timberline High School is located along Grasshopper Creek about 6 miles north of Weippe. About 200 students and faculty attend the High School from September to June. Hutchins Lumber, Inc. is a sawmill and lumber yard located within the City of Weippe. This mill is the largest employer within the City of Weippe. The yard is located along a small tributary that flows south into Jim Ford Creek.

Mining: The Jim Ford Creek has limited mining activities. The Idaho Department of Lands (IDL) land inventory system has nine recorded surface mining applications in the watershed. These records indicate mining operations which have filed a mine reclamation plan with IDL. They represent rock and gravel extraction sites. Five of these recorded sites are located in the Grasshopper Creek subwatershed, two are in the lower Jim Ford Creek subwatershed, one is in the Winter Creek subwatershed, and one is in the Kamiah Gulch subwatershed.

Roads: There are approximately 77 miles of roads within the watershed excluding urban streets. Included in this total are the following:

Secondary Highway	25 miles
Other Paved	6 miles
Improved Dirt	46 miles

Hydropower: A small hydroelectric facility is located below the City of Weippe at the beginning of the canyon portion of the creek. This facility was licensed in 1986 and constructed in 1987 and contains a small impoundment structure and diversion conduits into power generating turbines. It includes a 52 foot long, 5 foot high diversion dam that diverts water from a 6,200 foot section of the creek. The reservoir impounded by the diversion dam has a surface area of less than 1/4 acre, a maximum surface elevation of 2,963 feet, and a gross storage capacity of less than 1 acre-foot. Diverted water travels through a 6,900 foot long steel conduit along the south slope of the canyon. A 1,140 foot penstock conveys the diverted flow 365' vertical feet down the mountain slope to a powerhouse. Return flow re-enters Jim Ford Creek within the canyon portion, 1/4 mile downstream of the 65 foot waterfall. A minimum flow of 3

cfs must be maintained within the bypass reach along with an annual 2 week long flushing flow of 200% of the mean annual flow (FERC 1986). A penstock failure and resulting landslide occurred in April 1988. The landslide was estimated at 150 cubic yards (Clapperton 1999a).

2.1.7.3 Land Ownership

Figure 10 indicates current land ownership in the watershed and Table 7 provides a land ownership summary by subwatershed. Land ownership for the entire watershed is 2% NPT, 35% State, and 63% private.

Table 7. Land Ownership Acreage by Subwatershed

Land Owner	Lower Jim Ford	Upper Jim Ford	Winter	Grasshopper	Heywood	Miles & Wilson	Totals and percentage
Potlatch	8,806	1,271	4,953	4,069	512	486	20,097 30%
Other Private	7,863	5,579	860	3,824	1,714	1,282	21,122 32%
State	1,648	5,680	1,469	2,693	5,111	6,399	23,000 35%
NPT	1,601						1,601 2%
BLM	18						18 <1%
Totals	19,936	12,530	7,282	10,586	7,337	8,167	65,838

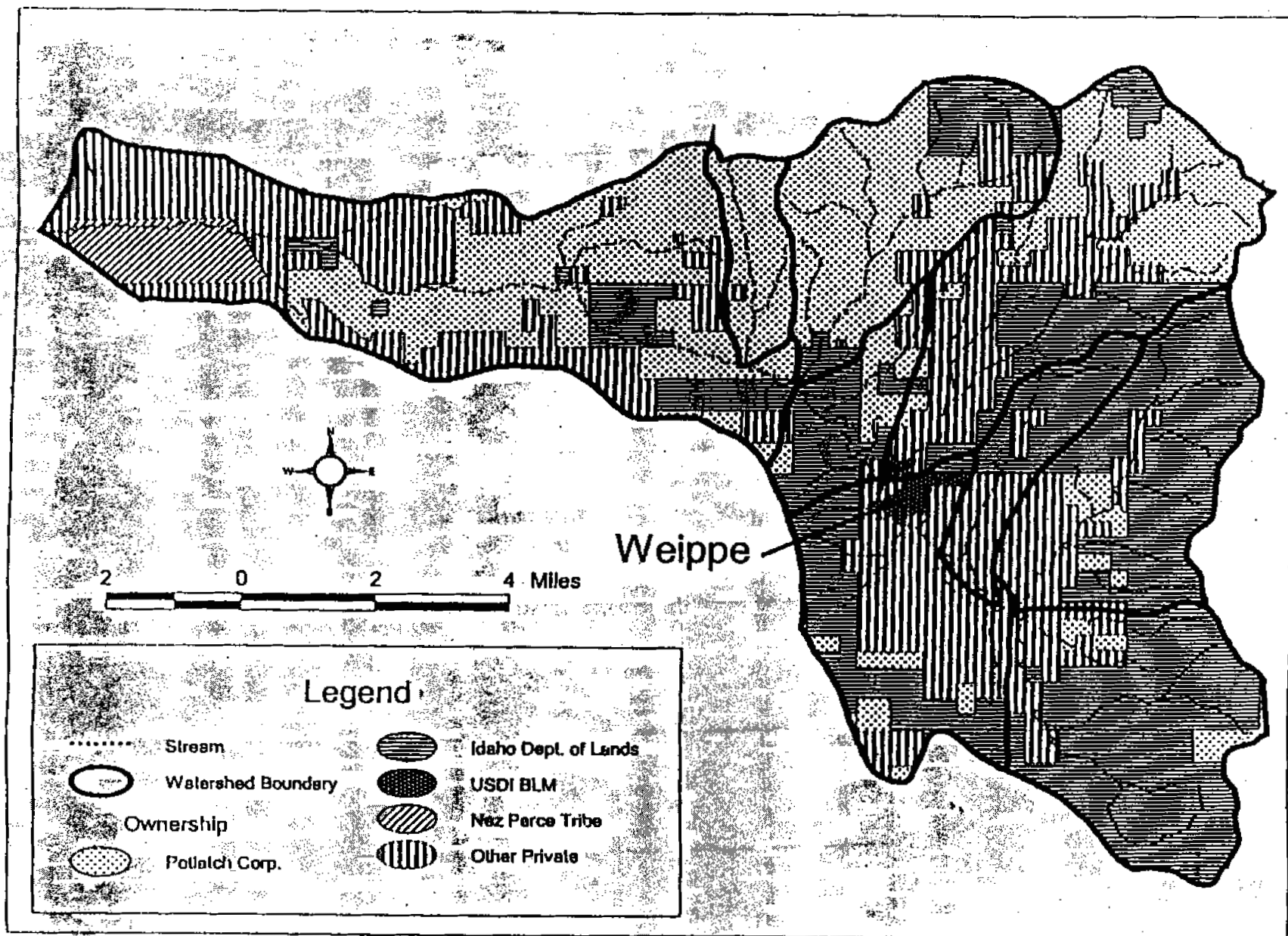


Figure 10. Ownership of the Jim Ford Creek Watershed

2.2 Water Quality Assessment

2.2.1 Applicable Water Quality Standards

This section provides background on the watershed segments and pollutants of concern on the § 303(d) list of impaired waters and describes applicable water quality standards.

2.2.1.1 Water Quality Limited Segments

The Federal Clean Water Act (CWA) requires restoration and maintenance of the chemical, physical, and biological integrity of the nation's waters (33 USC §§1251-1387). States and tribes, pursuant to §318 of the CWA, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the water whenever attainable. Section 303(d) of CWA establishes requirements for states and tribes to identify and prioritize waterbodies which are water quality limited (i.e. waterbodies which do not meet water quality standards). States and tribes must publish a priority list of impaired waters every two years. For waters identified on this list, states and tribes must develop a TMDL set at a level to achieve water quality standards.

In 1983 Jim Ford Creek was designated a first priority stream segment through the State's Agricultural Pollution Abatement Plan. After completion of the 1988 Idaho Water Quality Status Report and Nonpoint Assessment, Jim Ford Creek was designated a water quality limited segment from the headwaters to the mouth by IDEQ (1988). In 1994, 1996, and again in 1998, Jim Ford Creek was classified as a high priority water quality limited segment under §303(d) of the Clean Water Act. Pollutants of concern listed for Jim Ford Creek are sediment, temperature, nutrients, dissolved oxygen, pathogens, ammonia, oil and grease. Jim Ford Creek was also identified as impaired from habitat and flow alteration on these § 303(d) lists.

Grasshopper Creek, a tributary to Jim Ford Creek, was also listed as water quality limited in 1994, 1996, and again in 1998. Pollutants of concern listed for Grasshopper Creek are nutrients, sediment, temperature, and pathogens. Grasshopper Creek was also identified as impaired from habitat and flow alteration on these §303(d) lists.

2.2.1.2 Designated Beneficial Uses

Surface water beneficial use classifications are intended to protect the various uses of surface water bodies. Idaho waterbodies which have designated beneficial uses are listed in Idaho's Water Quality Standards and Wastewater Treatment Requirements (IDHW 1996). They are comprised of five categories: aquatic life; recreation; water supply; wildlife habitat; and aesthetics.

Aquatic life classifications are for water bodies which are suitable or intended to be made suitable for protection and maintenance of viable communities of aquatic organisms and populations of significant aquatic species. Aquatic species include cold water biota, warm water biota, and salmonid spawning.

Recreation classifications are for water bodies which are suitable or intended to be made suitable for primary contact recreation and secondary contact recreation. Primary contact recreation depicts prolonged and intimate contact by humans where ingestion is likely to occur. Secondary contact recreation depicts recreational uses where ingestion of raw water is not probable.

Water supply classifications are for water bodies which are suitable or intended to be made suitable for agriculture, domestic, and industrial uses. Wildlife habitat waters are those which are suitable or intended to be made suitable for wildlife habitat. Aesthetics are applied to all waters.

Designated beneficial uses of the mainstem of Jim Ford Creek include: cold water biota; primary contact recreation; secondary contact recreation; and agricultural water supply (IDAPA 16.01.02). Designated beneficial uses for Grasshopper Creek, a tributary to Jim Ford Creek, include domestic water supply, agricultural water supply, cold water biota, primary contact recreation, and secondary contact recreation. Tributaries to Jim Ford Creek without specific beneficial use designation in IDAPA 16.01.02 are given designations of cold water biota and primary or secondary contact recreation (IDAPA 16.01.02.101.01).

The presence of salmonids has been documented within Jim Ford Creek below the waterfall. Therefore, the associated water quality criteria for salmonid spawning will be considered in this TMDL for that segment below the waterfall. Conditions in the upper watershed affect conditions in the lower watershed and so the TMDL addresses what changes are needed in the upper watershed to support salmonids in the lower watershed, such as changes to cool water temperatures.

2.2.1.3 Surface Water Quality Criteria

Appendix A details the applicable surface water quality standards for Jim Ford Creek that are summarized in Table 8. Idaho water quality standards include criteria necessary to protect designated beneficial uses. The standards are divided into three sections: General Surface Water Criteria; Surface Water Quality Criteria for Use Classifications; and Site-Specific Surface Water Quality Criteria (IDHW 1996). The numeric criteria that exist in these rules for fecal coliform bacteria, temperature, ammonia, and dissolved oxygen will be used in the TMDL. The criteria for nutrients, sediment, and oil and grease are narrative criteria that indicate levels of these pollutants cannot exceed quantities that impair beneficial uses. Because these pollutants do not have numeric criteria, surrogate numeric targets are proposed in the TMDL.

Table 8. Jim Ford Creek Surface Water Criteria (refer to Appendix A for details on applicable state standards).

Pollutant	Statement in Idaho Code 16.01.02
Sediment	<p>Idaho General Water Quality Criteria - Sediment shall not exceed quantities which impair beneficial uses.</p> <p>Idaho State Turbidity Criteria for Cold Water Biota - Turbidity not to exceed background by more than 50 NTU instantaneously or 25 NTU for more than 10 consecutive days.</p>
Temperature	<p>Idaho State Criteria for Cold Water Biota and Salmonid Spawning - Cold Water Biota: 22°C (72°F) daily maximum at any time; 19°C (66°F) daily average. Salmonid Spawning: 13°C (55°F) daily maximum and 9°C (48°F) daily average. These criteria apply only during actual spawning period for the salmonid species present. The default or assumed spawning periods from Jan. 15 to July. 15 for rainbow trout; Feb. 1 to July 15 for steelhead trout; Aug. 1 to April 1 for spring chinook salmon; and Aug. 15 to June 15 for summer chinook salmon.</p>
Nutrients	<p>Idaho State Criteria for Excess Nutrients - Surface waters shall be free from excess nutrients that can cause visible slime growth or other nuisance</p>
Pathogens	<p>Idaho State Criteria for Primary and Secondary Recreation -</p> <p>Secondary (October through April): Monthly geometric mean fecal coliform concentrations not to exceed 200 colony forming units (cfu)/100 mL at any time; or 800 cfu/100 mL instantaneous; or 400 cfu/100 mL in more than 10% of samples taken over a 30 day period.</p> <p>Primary (May through September): Monthly geometric mean fecal coliform not to exceed 50 cfu/100 mL; or 500 cfu/100 mL instantaneous; or 200 cfu/100 mL in more than 10% of samples taken over a 30 day period.</p>
Ammonia	<p>Idaho State Criteria for Cold Water Biota and Salmonid Spawning - As defined in tables in 16.01.02.250.c.iii (1) and (2); pH and temperature dependent.</p>
Dissolved Oxygen	<p>Idaho State Criteria for Cold Water Biota and Salmonid Spawning - Dissolved oxygen at 6 mg/L or greater at all times.</p> <p>Idaho State Criteria for Salmonid Spawning - Intergravel dissolved oxygen of 6 mg/L or greater weekly mean and 5 mg/L or greater daily minimum.</p>
Oil and Grease	<p>Idaho General Water Quality Criteria - Concentrations must be less than those found to impair beneficial uses.</p>

These water quality standards pertain to those times and locations where stream flow is non-intermittent. Idaho rule (IDAPA 16.01.02.003.50) defines an intermittent stream as, "A stream which has a period of zero flow for at least one week during most years. Where flow records are

available, a stream with a 7Q2 hydrologic-based design flow of less than one-tenth (0.1) cfs is considered intermittent. Streams with perennial pools which create significant aquatic life uses are not intermittent." Stream segments of zero flow occur between perennial pools within the upper portions of the Jim Ford Creek watershed. Therefore, these Idaho water quality standards may or may not apply to some of the upper portions of the Jim Ford Creek basin during low flow times of the year.

Idaho water quality standards pertaining to point source discharges stipulate that if a designated mixing zone exists in a flowing receiving water, "The mixing zone is not to include more than 25% of the volume of the stream" (IDAPA 16.01.02.060.01.e.iv). In recognition that Jim Ford Creek flow volumes are not large enough to support an adequate mixing zone during the low flow seasons of the year, the current National Pollutant Discharge Elimination System (NPDES) permit states that the Weippe WWTP may only discharge into Jim Ford Creek when there is available dilution. TMDL targets and allocations (Section 3.0) for the Weippe WWTP take both the flow and pollutant concentrations present within Jim Ford Creek into consideration. Also, in the case of permitted point source discharges, additional stipulations for the mixing of wastewater discharge may be applied (IDAPA 16.01.02.401.03). These and other considerations specific to the WWTP point source discharge will be determined by the local IDEQ permitting engineer during 401 permit certification.

2.2.1.4 Drinking Water Quality Criteria

The State of Idaho Department of Health and Welfare (IDHW) is the primary agency responsible for the protection of public drinking water in the State of Idaho. Idaho Rules for Public Drinking Water Systems include criteria necessary to protect all domestic water supplies. Requirements have been set forth for treatment techniques (IDAPA 10.01.08.500), design standards (IDAPA 10.01.08.550), and operating criteria for public drinking water systems (IDAPA 10.01.08.552).

Drinking water systems are classified according to whether a system is a public system and the number of people usually served. Grasshopper Creek has a designated beneficial use of domestic water supply. According to Dekan (1998) and King (1998), Grasshopper Creek does not currently serve any public drinking water supply systems. Additionally, no non-community (transient or non-transient) water systems along Grasshopper Creek have been identified. However, water originating within the Jim Ford Creek watershed flows into the Clearwater River, a public drinking water supply for Orofino and Lewiston. These and other surface sources of drinking water must maintain filtration and disinfection systems intended to maintain safe drinking water for their customers (IDAPA 16.01.08.550.05).

2.2.2 Available Water Quality and Aquatic Life Data

This section summarizes the surveys conducted to determine whether beneficial uses are supported in the watershed, other aquatic life surveys, and water quality studies performed in the watershed.

2.2.2.1 Beneficial Use Support Studies

IDAPA 16.01.02.053 establishes a procedure to determine whether a water body fully supports designated and existing beneficial uses, relying heavily upon aquatic habitat and biological parameters, as outlined in the *Water Body Assessment Guidance (WBAG)*. IDAPA 16.01.02.054 outlines procedures for identifying water quality limited waters which require TMDL development, publishing lists of Water Quality Limited waterbodies, prioritizing waterbodies for TMDL development, and establishes management restrictions which apply to water quality limited waterbodies until TMDLs are developed.

IDEQ conducted Beneficial Use Reconnaissance Project (BURP) surveys on Jim Ford Creek in 1995, 1997, and 1998 (IDEQ 1995, 1997, and 1998). The NPT conducted BURP surveys on Jim Ford Creek in 1997 and 1998 using IDEQ protocols (NPT 1997 and 1998). The BURP survey collects data on fish, macroinvertebrates and habitat to determine a water body's beneficial uses and the support status of those uses for Idaho State water quality standards (IDEQ 1996).

Two segments of the mainstem of Jim Ford Creek were surveyed in 1995, Lower Jim Ford Creek about 8 miles from the mouth, and Upper Jim Ford Creek about ½ mile east of Weippe. Grasshopper Creek was also surveyed about 3 ½ miles upstream from its confluence with Jim Ford Creek. The 1995 BURP data were analyzed using the WBAG document (IDEQ 1996).

At the lower site within the canyon portion of Jim Ford Creek the stream temperature was found to be 18 °C when steelhead and rainbow trout are expected to be spawning. This is 5 °C higher than the current Idaho water quality daily maximum temperature standard for spawning and rearing. This is deemed a major exceedence under the 1996 WBAG (IDEQ 1996); consequently, the site was assessed as not in full support. The macroinvertebrate biotic index score was 3.61, which is not considered impaired according to the WBAG.

The data from the BURP site on Upper Jim Ford Creek were incomplete because the stream was not wadeable at the time of the survey; therefore, the site was not assessed for beneficial use support. A sample of macroinvertebrates was taken from the banks; the MBI score was 2.62, which is assessed as needs verification using the 1996 WBAG since it falls between the range for impaired (MBI is ≤ 2.5) and not impaired (MBI ≥ 3.5). Needs verification means further data are required to determine whether beneficial uses are supported. Until that data are collected, the site is addressed as one where beneficial uses are not supported.

The overall status of the beneficial uses on Grasshopper Creek was determined to be within a "needs verification" category. This category was selected because the MBI score of 3.09 fell between the "impaired" and "not impaired" range. Domestic water supply, agricultural water supply, and primary and secondary contact recreation were not assessed. However, fecal coliform data collected during the summer of 1997 indicated that primary and secondary contact recreation uses are not supported in Grasshopper Creek at this time (ISCC 1997).

In 1997, BURP surveys were conducted again at Lower Jim Ford Creek near the mouth and

Upper Jim Ford Creek about ½ mile upstream from Weippe. In 1998, BURP surveys were conducted at Lower Jim Ford Creek between the waterfall and hydroplant, Lower Jim Ford Creek about four miles upstream of the mouth, at the mouth of Heywood and Winter creeks, and at Wilson Creek approximately 1½ mile from its confluence with Miles Creek. However, the data from these surveys have not been evaluated for beneficial use support due to pending revisions in the 1996 WBAG. In addition, MBI scores have not been determined on the 1997 and 1998 BURP samples.

Appendix B contains a summary of all the BURP surveys, including a comparison of results to literature reference conditions for salmonid spawning and rearing. Table 9 provides a summary of the BURP surveys and status calls.

Table 9. Summary of BURP Surveys and Status Calls

Site ID	Survey Date	Location	Status Call
95NCIROB08	6/26/95	Grasshopper Creek	Needs verification
95NCIROB24	7/25/95	Upper Jim Ford Creek; ½ mile east of Weippe	Data incomplete; not assessed
95NCIROB11	6/30/95	Lower Jim Ford Creek, 8 miles from mouth	Not full support
97NCIROC40	9/10/97	Upper Jim Ford Creek, ½ mile upstream of Weippe	Not assessed
97NCIROZ05	6/25/97	Lower Jim Ford Creek near mouth	Not assessed
1998SLEWA05	6/25/98	Lower Jim Ford Creek between falls and hydroplant	Not assessed
1998SLEWA10	7/6/98	Mouth of Heywood Creek	Not assessed
1998SLEWA11	7/7/98	Wilson Creek 1 ½ miles upstream of confluence with Miles Creek	Not assessed
1998SLEWA12	7/7/98	Mouth of Winter Creek	Not assessed
1998RNPTA00	7/6/98	Lower Jim Ford 4 miles upstream of mouth	Not assessed

Stewart (1999) conducted a fisheries evaluation for the upper portion of Jim Ford Creek. Stewart concluded the fish species identified above the falls appear well suited for the existing conditions in that portion of Jim Ford Creek. Higher water temperatures with low velocities, turbid water, and embedded stream bottom substrate are conditions which favor the fish species present above the falls.

2.2.2.2 Other Aquatic Life Surveys

In 1984, the NPT conducted fisheries and water quality surveys in the Clearwater Basin, which included a survey near the mouth of Jim Ford Creek (Kucera 1984). The study characterized Jim Ford Creek as having good habitat conditions within the canyon portion of the watershed, but low fish populations. The steelhead trout density was 2.0 fish/100 m². High stream temperature during the summer, a lack of instream cover, high iron, and excessive algae growth (nutrients) were cited as contributing factors for low fish density scores.

Hoffman (1992) electroshocked at the mouth of Jim Ford Creek on August 2, 1991 and found fish species consisting of dace, sculpin, rainbow trout, northern squawfish, small mouth bass, bridgeline sucker, and steelhead trout. Insufficient numbers of individual fish species were collected to generate fish population or density estimates.

Reconnaissance-level monitoring for benthic macroinvertebrates was conducted at the mouth of Jim Ford Creek for the purpose of developing a qualitative assessment of biotic condition (Hoffman 1992). Macroinvertebrate information collected provides metrics for estimating the relative abundance of the macroinvertebrate community present and the ratio of pollution sensitive indicator groups such as mayflies (Ephemeroptera), caddisflies (Trichoptera), and stoneflies (Plecoptera). The macroinvertebrates data biotic index was high at the mouth of Jim Ford Creek and all orders of the pollution sensitive mayflies, caddisflies, and stoneflies were represented in the kick net samples.

The trophic structure of the Jim Ford Creek macroinvertebrate community was divided into scrapers, filterers, and shredder functional feeding groups. The 9.7% scrapers reflect the riffle community food base, indicating the availability of periphyton (attached algae). The filterers comprised 27.6% of the sample, indicating an abundance of fine particulate organic matter. The fact that the shredder community was not represented might be indicative of a poor, upstream riparian habitat (Hoffman 1992).

Additional assessments for Jim Ford Creek by various agencies included: 1) an assessment by IDEQ (1992) that indicated future salmonid spawning use as is desired within the upper portion of the Jim Ford Creek; 2) an assessment by Allen et al. (1986) that considered Jim Ford Creek as a "substantial resident fish resource;" and 3) Assessments USFWS (1978) and IDFG (1992) that described Jim Ford Creek habitat as "occasionally used by a highly-valued population..." (namely salmonid spawning in the lower canyon reach).

Results of 1984 and 1998 fish density studies by the NPT are provided in the Section 2.1.6 on fisheries. Results of a 1999 R1/R4 Habitat Survey are provided in Appendix E.

2.2.2.3 Water Quality Studies

In 1979, the Idaho Division of Environment conducted a water quality study on Jim Ford Creek to assess the impact of the Weippe WWTP discharge and nonpoint sources on Jim Ford Creek. In the study, one tributary and two sewage discharge stations were monitored bimonthly. Results indicated that Jim Ford Creek had consistent bacteria levels that exceed criteria and high levels of iron and turbidity. The study concluded that the bacteria problem could be eliminated by upgrading the City of Weippe sewage treatment facilities and reducing the discharge when the stream dilution is less than 50:1, which the City has done. The application of agricultural and silvicultural best management practices were recommended to address the iron and turbidity problems (IDEQ 1980).

An Environmental Assessment was written in response to an application by Ford Hydro Limited Partnership for a minor hydropower license along Jim Ford Creek, just downstream of the City of Weippe (FERC 1985). A cumulative impacts analysis addressing impacts from this and other hydropower projects within the Clearwater River basin identified resources that might experience adverse impacts. These target resources include chinook salmon, steelhead trout, mule deer, whitetail deer, elk, upland game birds, and riparian habitat. Overall findings on the Ford's Creek Hydro Project within the Environmental Assessment found that no cumulative adverse impacts to these target resources would result from the project, mainly due to the already existing barrier to anadromous fish migration within the project reach. The Environmental Assessment stated that the proposed erosion control measures contained in the application would minimize the impacts of construction related erosion and sedimentation to fishery resources downstream. The assessment indicated that, during operation, the diversion structure would enhance the water quality by trapping sediment, thus possibly improving downstream habitat for salmonids.

In 1986, IDEQ conducted a water quality study on Jim Ford Creek during the summer low flow period to estimate the impact that the Weippe WWTP effluent would have on water quality. It was determined from this study that the water quality of Jim Ford Creek did not meet the minimum state water quality criteria for primary contact recreation, cold water biota, or salmonid spawning beneficial uses. Dissolved oxygen concentrations were also below the criteria set for the designated uses as the result of inadequate dilution of the wastewater discharge (IDEQ 1987).

The 1988 Idaho Water Quality Status Report and Nonpoint Source Assessment indicated that Jim Ford Creek is not supporting salmonid spawning, cold water biota, and primary/secondary contact recreation uses. Agricultural water supply was reported as supported, but threatened (IDEQ 1988).

Harvey (1990) reviewed existing data and concluded that non-irrigated agriculture, grazing, forestry and hydropower development were significant nonpoint sources in the Jim Ford Creek watershed. The following general problems were identified from those sources: 1) erosion from fields on rolling terrain causing high sediment yield; 2) stream channelization through the farmland causing streambank instability and additional sedimentation; 3) grazing along stream banks adding to loss of bank stability and to fecal coliform contamination; 4) extensive forest

harvest and associated haul roads causing increased sedimentation; and 5) two failures at the hydropower plant causing channel alteration and sedimentation. The Weippe WWTP was also identified causing exceedances of water quality criteria during summer discharge period.

Impacts of the treated wastewater discharge (e.g. ammonia and bacteria) were found to mask the many impacts of the nonpoint sources in the drainage in many studies conducted prior to 1992. Since that time, the WWTP has discharged only during those times when there is opportunity for adequate dilution within Jim Ford Creek.

A 1991 stream/riparian habitat inventory of Jim Ford Creek 1.3 miles upstream from the mouth revealed 61% canopy cover and 100% stable/uncovered stream banks (Hoffman 1992). A similar reconnaissance level effort was conducted on Grasshopper Creek above Weippe, indicating 5% overhead canopy cover and 100% covered and stable stream banks. The stream banks at the Grasshopper Creek site were found to be 80% undercut.

In 1993 the Clearwater Soil and Water Conservation District (CSWCD), in cooperation with the Idaho Soil Conservation Commission (ISCC), the USDA Soil Conservation Service (now the National Resource Conservation Service) (NRCS), and the IDEQ, completed an Agricultural Pollution Abatement Plan (CSWCD 1993). Stream temperatures, sediment load, and stream channel conditions monitored during 1991 were presented within this report. Excessive stream temperatures were observed on numerous occasions during the salmonid spawning and late summer periods. Sediment loads measured within Jim Ford Creek and two tributaries did not indicate excessive turbidity or total suspended solids loads. Studies examining channel substrate conditions within Jim Ford Creek and tributaries found that the cobble substrate at the mouth of Jim Ford Creek was only 24% embedded with no surface fines present. This level of cobble embeddedness is not considered a problem.

In 1997 TerraGraphics Environmental Engineering prepared a Storm Water Pollution Prevention Plan of Hutchins Lumber, Inc. (TerraGraphics 1997). This plan was revised by Blue Ribbon Environmental Products in spring 1999. Hutchins Lumber, Inc. is located within the City of Weippe along a small tributary to Jim Ford Creek. Possible pollution constituents generated from the storm water runoff are suspended solids and organics from stored and decomposing wood. Other possible pollutants generated at the site include petroleum products resulting from spills and equipment maintenance. No monitoring data were collected at the site, but it was stated that no significant toxic or hazardous spills or leaks have been reported in the last three years. Storm water controls were implemented at this Facility in 1999.

A fecal coliform survey study was conducted during the summer of 1997 in order to assess the magnitude of bacterial impacts due to nonpoint activities within the Jim Ford Creek waters (ISCC 1997). Samples collected during the recreation season (May through September) show

numerous exceedances of state water quality criteria for primary contact recreation in upper portions of the watershed.

Limited temperature monitoring conducted by IDEQ at the mouth of Jim Ford Creek in 1997 indicated a few exceedances in late August of cold water biota temperature criteria. No 1997 monitoring occurred during the salmonid spawning period, however, for comparison to salmonid spawning temperature criteria.

During the high flow period of 1998 grab samples were collected from Jim Ford Creek, tributaries, and known point sources (IDEQ 1998). These samples were tested for pH, turbidity, total suspended solids, ammonia, nitrate and nitrite, total phosphorous, fecal coliform, and oil and grease. Turbidity levels were found to be continuously greater than 25 NTU upstream of Weippe. Levels of total phosphorous were found to be high throughout the watershed. However, cold stream temperatures and limited sunlight during this period limited the amount of algae growth. Other parameters tested appeared to be well within the State water quality criteria set forth for the designated beneficial uses within the Jim Ford Creek watershed (i.e. cold water biota, domestic water supply, and primary and secondary recreation).

During the low flow period of 1998 grab samples were collected from Jim Ford Creek, tributaries, and known point sources (IDEQ 1998). These samples were tested for pH, turbidity, total suspended solids, ammonia, nitrate and nitrite, total phosphorus, fecal coliform, and *E. coli*. Point source discharge sampling at the Weippe and Timberline High School wastewater treatment plants was discontinued in June when discharges were discontinued. Levels of fecal coliform exceeded criteria in the upper portion of the watershed during summer months. *E. coli* levels correlated well with fecal coliform levels in terms of occurrences and sampling locations with elevated concentrations. Levels of phosphorus and nitrogen compounds were high enough to stimulate algal and macrophyte plant growth. High stream temperatures and ample sunlight during the low flow season also act to stimulate algae growth within Jim Ford Creek and its tributaries. Algae growths consisting primarily of green algae were observed at locations in the upper watershed. Levels of total suspended solids were overall low and below levels believed to impair beneficial uses. Turbidity and ammonia levels did not exceed state criteria. These data are the major data source for the TMDL and is described in further detail in the Section 2.2.3.

Between June and October 1998, temperatures were recorded by thermographs every 1.6 hours at various locations in Jim Ford Creek and its tributaries (IDEQ 1998). Summertime temperatures exceeded criteria in both the lower and upper portions of the watershed.

A follow-up assessment on the Ford's Creek Hydroplant by the IDEQ during the spring of 1998 supported the FERC finding that the diversion structure traps sediment (Luce 1998). However, instabilities created along the canyon wall between the penstock intake and the powerhouse caused a landslide in 1988 with direct entry to the Jim Ford Creek stream system that resulted in the deposition of large rock fragments.

In 1997 and 1998 the IDL performed a Cumulative Watershed Effects (CWE) analysis of the Jim Ford Creek watershed using the standard procedures of the Forest Practices Cumulative Watershed Effects Process for Idaho (IDL 1995). The CWE methodology is designed to examine

conditions of the forested lands in the watershed in and around a stream. It then attempts to identify the causes of any adverse conditions. Finally, it helps identify actions that will correct any identified adverse conditions. The CWE process consists of seven specific assessments: erosion hazard, canopy closure/stream temperature, hydrologic risk, sediment delivery, channel stability, nutrients, and beneficial use/fine sediment. Although the process is designed for forested lands, the CWE evaluation of Jim Ford Creek covered some non-forested lands. Stream segments evaluated were Lower Jim Ford, Shake Meadow Creek, Winter Creek, Middle Jim Ford, Upper Jim Ford, Kamiah Gulch, Grasshopper Creek, Heywood Creek, and Miles/Wilson Creek. A CWE nutrient assessment was not conducted because the Jim Ford Creek watershed does not contain a lake or reservoir and does not flow into a lake or reservoir.

The CWE report is contained in Appendix C. The summary data from this report are shown in Table 10. Surface erosion and mass failure hazards are derived from landtype associations and can range from low to high. The moderate ratings for the majority of the Jim Ford Creek reaches evaluated indicate that there is some risk for both of these throughout the watershed. The stream temperature ratings can be high or low, with the high rating for the lower reaches of Jim Ford Creek indicating that there is a high likelihood that the canopy cover is insufficient to maintain stream temperatures within the target. The lower reach is then treated as under an adverse condition requiring further analysis and/or the development of site specific best management practices. Hydrologic risk ratings may be low, moderate, or high, with low indicating no particular problem, moderate indicating the situation should be considered, and high, which does not occur in Jim Ford, would indicate an adverse condition. The moderate rating for Grasshopper Creek is mostly the result of channel instability, while that of the Miles/Wilson Creek watershed is a combination of both channel instability and percent canopy removal. The sediment delivery rating based on evaluation of roads, skid trails, and mass failures were all low, indicating that little sediment is being produced from these sources. As a result of the CWE process using Global Position System (GPS) to log individual road segments, those which were identified as having high ratings in and of themselves are on record as needing attention. As part of the CWE analyses, road density in forested areas were estimated. Table 11 presents road density by subwatershed. The significance of the road density values are addressed in Appendix B.

In conclusion, the only adverse condition identified by CWE for forestry in the Jim Ford Creek watershed is the lack of shading for the reaches of the stream below the falls. In general, the landowners there are asking for further analysis of the situation, which will be coordinated with the development and implementation of a TMDL for the Jim Ford Creek watershed (refer to Appendix C).

Table 10. CWE Analysis Summary

Subwatershed	Surface Erosion Hazard	Mass Failure Hazard	Stream Temperature	Hydrologic Risk Rating	Sediment Delivery	BURP Fine Sediment
Lower Jim Ford sidewalls	Moderate	Moderate	High	Low	Low	Not Full Support
Shake Meadow	Moderate	Moderate	Low	NA	NA	
Winter	Moderate	Moderate	Low	Low	Low	
Upper Jim Ford sidewalls	Moderate	Moderate	Not Assessed	Not Assessed	Not Assessed	
Middle Jim Ford sidewalls	Moderate	Moderate	Not Assessed	Not Assessed	Not Assessed	
Kamiah Gulch	Moderate	Moderate	Low	Low	Low	
Grasshopper	Low	Moderate	Low	Moderate	Low	Not Full Support
Heywood	Low	Low	Low	Low	Low	
Miles/Wilson	Moderate	Moderate	Low	Moderate	Low	

Table 11. Road Density by Subwatershed

Subwatershed	Acres	Road Miles	Density (mile/sq. mile)
Lower Jim Ford	17,984	129	4.59
Shake Meadow	1,951	21	6.89
Winter Creek	7,282	62	5.45
Upper Jim Ford	7,151	55	4.92
Middle Jim Ford	2,688	20	4.76
Kamiah Gulch	2,690	15	3.57
Grasshopper	10,586	95	5.74
Heywood	7,337	59	5.15
Miles and Wilson	8,167	55	4.31
Total	65,838	509	4.97

2.2.3 Water Quality Conditions

The 1996 §303(d) list for the State of Idaho lists 7 pollutants of concern for Jim Ford Creek: sediment; temperature; pathogens; nutrients; dissolved oxygen; ammonia; and oil and grease. This section summarizes trends exhibited for these pollutants relative to exceedance of criteria, primarily using 1998 reconnaissance sampling data. 1998 sampling locations are shown in Figure 11.

In addition to these seven pollutants, habitat and flow alteration were listed on the §303(d) lists for Jim Ford Creek. Because habitat and flow parameters are not pollutants, they have no criteria, and they are not suitable for estimation of load capacity or load allocations, TMDLs will be not developed for these parameters. Actions taken to address pollutants of concern such as sediment, temperature, and nutrients, may address flow and habitat alteration as well.

2.2.3.1 Sediment

The sediment standard in Idaho rules is a narrative standard that states sediment shall not exceed, "...in the absence of specific sediment criteria, quantities which impair designated beneficial uses" (IDAPA 16.01.02.200.08). Sediment is typically classified into 2 size fractions based on impact to aquatic life: 1) fine sediment that consists primarily of sand to clay size particles and is transported as suspended and washload; and 2) coarse bed-material generally of coarse sand and larger that is carried as bedload along the stream bed.

There are many indicators of sediment impacts to water quality: 1) water column sediment indicators such as total suspended solids (TSS) and turbidity that measure fine sediment; 2) streambed sediment indicators such as percentage of fine particles less than a certain critical size or cobble embeddedness; 3) other channel indicators such as width/depth ratio or pool/riffle ratio; 4) biological indicators such as those based on fish or aquatic insect numbers and diversity; and 5) riparian or hillslope indicators such as bank stability or woody debris. To help quantify the appropriate indicators, The Jim Ford Creek 1998 and 1999 sampling efforts collected total suspended solids, turbidity, and channel stability and habitat data which are summarized below and in Appendix D and E.

2.2.3.1.1 Water Column Sediment - Turbidity and TSS

This section reports the data and analysis used to evaluate the high flow concentrations of turbidity and total suspended solids (TSS) of Jim Ford Creek. In early 1999, the Jim Ford Creek Technical Advisory Group (TAG) agreed to implement a synoptic high flow sampling event to help determine if the levels of turbidity and TSS are violating water quality standards and impairing beneficial uses. Based on these and 1998 data, the Jim Ford TAG concluded that TSS and turbidity are not impairing beneficial uses.

Jim Ford - Grasshopper Watersheds

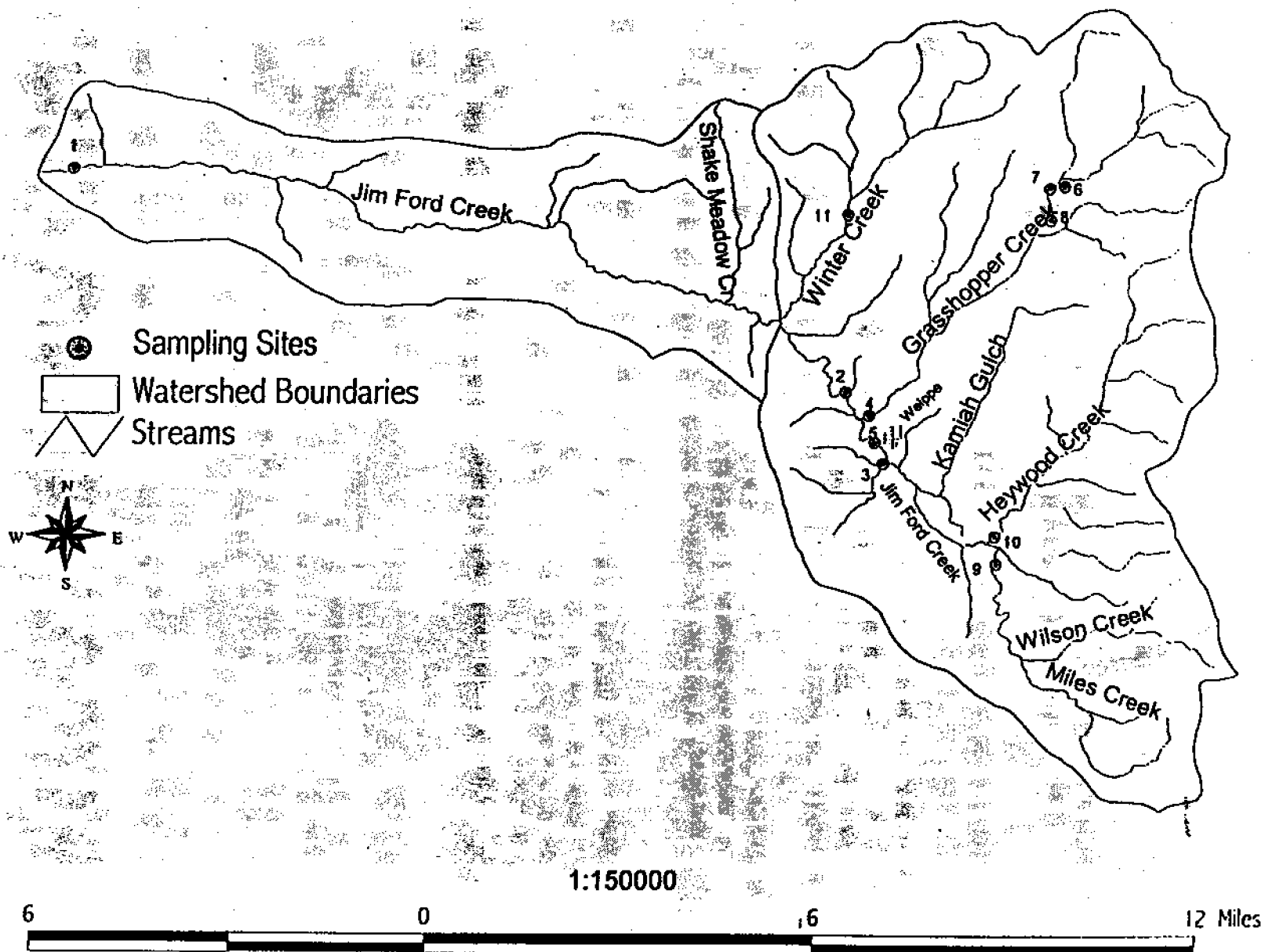


Figure 11. 1998 Sampling Locations

The Jim Ford Creek turbidity and TSS monitoring follows standard sample collection and analysis procedures. Weekly turbidity measurements were taken by the CSWCD at 4 sites along Jim Ford Creek. These sites include: 1) Wilson Creek; 2) upstream of Weippe; 3) downstream of Weippe; and 4) Grasshopper Creek. The TSS samples were taken coincident with turbidity measurements at these 4 sites. Wilson Creek is used as a background site. Sampling focussed on the upper watershed based on 1998 data that indicated the possible exceedances of State 10-day turbidity criteria.

Depth integrated TSS samples are taken using the Equal Width Increment method and a DH-81 sampler according to USGS protocols (Edwards and Glysson 1998). Grab samples are also taken at sites where the Equal Width Increment method is not possible. Samples were split and turbidity was measured in the field with a HACH 2100P which has an accuracy of $\pm 2\%$ of the reading. TSS samples were put on ice and cooled to 4°C and sent to the Idaho state water quality lab. Stream discharge was measured using standard USGS technique and a Marsh McBirney velocity meter.

The synoptic turbidity-TSS monitoring collected a total of 31 regular samples and 6 duplicate samples. The concentration of regular and duplicate samples are generally within 30% of each other (Table 12). One sampling event compared the grab versus depth integrated sampling techniques. One sample is not enough to rigorously evaluate the two methods, however, they generally agree with the greatest error apparent between the TSS samples (Table 12). The reduced turbidity and TSS data are reported in Table 13.

The turbidity and TSS data indicate the following: 1) there are no substantial turbidity criteria violations during the high flow event of 1999; 2) TSS values are generally within a protective range (i.e. 25 - 80 mg/L) (IDEQ 1999); 3) TSS duration of exposure cannot be determined from these data; 4) turbidity and TSS do not appear to be a function of stream discharge; 5) adequate sampling precision appears to have been achieved; 6) a good relationship between TSS and turbidity exists; and 7) no substantial change above and below the city of Weippe. These and 1991 and 1998 ISCC turbidity and TSS data provided the basis for not developing a turbidity-suspended solids TMDL for Jim Ford Creek.

Table 12. Quality Assurance/Quality Control for Turbidity and TSS Samples

Site	Date	Flow (cfs)	Turb. (NTU)	TSS (mg/L)	Turbidity % Diff.	TSS % Diff.
Wilson Cr.	4/5/1999	2.72	7.9	3		33.3
	duplicate		N/A	2		
Above Weippe #3	3/24/1999	86+	22.5	13	-11.1	15.4
	duplicate		25.0	11		
	3/30/1999	99.04	27.8	13		-30.8
	duplicate		N/A	17		
	4/12/1999	75.92	20.3	6		-33.3
	duplicate		N/A	8		
	5/10/1999	18.84	21.3	5		-20.0
	duplicate		N/A	6		
Below Weippe #2	5/3/1999	N/A	45.6	31		-6.5
	duplicate	N/A	N/A	33		
Depth Integrated/Grab Comparison	3/24/1999	N/A	9.8	4	-10.2	-125.0
	3/24/1999	N/A	10.8	9		

Table 13. Turbidity and Total Suspended Solids Data Summary for Jim Ford Creek

Site	Date	Sample Type*	Flow (cfs)	Turb. (NTU)	TSS (mg/L)
Wilson Creek	3/12/99	DI	3.3	8.9	4.0
	3/18/99	DI	6.4	9.9	1.0
	3/24/99	GR	16.2	10.8	9.0
	3/30/99	DI	4.0	7.9	2.0
	4/5/99	DI	2.7	7.9	3.0
	4/12/99	DI	3.4	9.3	3.0
	5/3/99	DI	4.6	11.9	8.0
	5/10/99	DI	1.0	6.7	29.0
	5/26/99	DI	1.3	6.9	10.0
Above Weippe #3	3/12/99	DI	50.0	29.0	8.0
	3/18/99	DI	101.0	21.8	7.0
	3/24/99	GR	86.0	22.5	13.0
	3/30/99	DI	99.0	27.8	13.0
	4/5/99	DI	66.3	21.0	7.0
	4/12/99	DI	75.9	20.3	6.0
	5/3/99	DI	124.4	5302	39.0
	5/10/99	DI	18.8	21.3	5.0
	5/26/99	DI	2.5	21.3	13.0
Below Weippe #2	3/12/99	DI	59.3	24.6	7.0
	3/18/99	GR	N/A	20.9	5.0
	3/30/99	GR	N/A	22.2	8.0
	4/5/99	DI	87.9	18.1	4.0
	4/12/99	GR	N/A	16.9	6.0
	5/3/99	GR	N/A	45.6	31.0
	5/10/99	GR	34.6	17.0	2.0
	5/26/99	DI	5.6	15.8	11.0
Mouth of Jim Ford Creek	4/5/99	DI	N/A	17.1	4.0
	4/12/99	GR	N/A	16.9	4.0
	5/3/99	GR	N/A	26.7	18.0
	5/10/99	GR	N/A	13.3	2.0
	5/26/99	DI	14.1	6.1	6.0

* DI - depth integrated sample; GR - grab sample

2.2.3.1.2 Coarse Sediment

In early 1999, the Jim Ford Creek TAG agreed that there is not enough information to answer the question as to whether bedload is impairing beneficial uses and agreed to conduct a channel stability inventory and habitat survey to answer that question. The TAG also agreed that a more intensive study of actual bedload transport rates would not be appropriate given the TMDL deadline, limited resources, and characteristics of this watershed compared to others. Subsequently, the channel stability and habitat data gaps were filled in the summer of 1999, and the results are reported in Appendix D and E.

In summary, results of the habitat inventory showed low residual pool volume and high width to depth ratios in the lower gradient reaches ($< 1.5\%$). Results of the channel stability inventory showed that these lower gradient reaches are unstable as a result of excess cobble size bed-material. The hydrologic, geomorphic, and habitat data suggest that deposition of excess cobble size bed-material is likely impairing salmonids. Specifically, elevated sediment inputs from hillslope and channel sources within the lower Jim Ford Creek watershed are delivered to the lower gradient reaches where the stream's sediment carrying capacity is exceeded causing the channel to aggrade. Channel aggradation causes the width to depth ratio to increase, and the residual pool volume to decrease (Rosgen, 1996; Montgomery and Buffington 1993; Madej, 1999).

In late 1999, the Jim Ford Creek Watershed Advisory Group (WAG) and TAG decided that more information is needed to determine the relative impact of elevated sediment loads versus peak flood flow increases on channel stability. In addition, the TAG agreed that a more detailed sediment source analysis is warranted to help focus TMDL implementation efforts. The IDL and Potlatch Corporation have agreed to help complete these analyses within the next year. This sediment source analyses framework is available in the Jim Ford Creek TMDL administrative record. In the interim, an instream loading analysis is used to estimate the needed instream sediment reductions (Section 3.1).

In the year 2000, a sediment budget will be conducted to estimate the natural and anthropogenic instream and hillslope sediment production of coarse material observed instream. The sediment budget will not be used to evaluate the impact of sediment on beneficial uses. Rather, it will be used to estimate the relative contribution of natural and management caused sediment inputs. A flow analysis will be conducted to evaluate the causes and effects of frequent large floods.

The ultimate goal of the sediment TMDL is to stabilize the unstable reaches by reducing the amount of incoming coarse bed-material and possibly reducing the magnitude of peak flood events. To accomplish this, the sediment yield to aggrading reaches needs to be reduced to the point where the amount of instream sediment storage is no longer increasing and hopefully decreasing with time. Once sediment yield is reduced the stream will seek a new state of dynamic equilibrium, transition from a braided to meandering channel, and develop deeper pools and narrower channel.

2.2.3.2 Stream Temperature

The temperature of stream water usually varies on seasonal and daily time scales, and differs by location according to climate, elevation, extent of streamside vegetation and the relative importance of ground water inputs. Other factors affecting stream temperatures include: solar radiation, cloud cover, evaporation, humidity, air temperature, wind, inflow of tributaries, and width to depth ratio. Diel temperature fluctuations are common in small streams, especially if unshaded, due to day versus night changes in air temperature and absorption of solar radiation during the day.

Aquatic species are restricted in distribution to a certain temperature range, and many respond to the magnitude of temperature variations and amount of time spent at a particular temperature rather than an average value (MacDonald 1991). Although species have adapted to cooler and warmer extremes of most natural waters, few taxa are able to tolerate very high temperatures. Oxygen solubility is reduced at high water temperatures, which can compound the stress on fish caused by marginal dissolved oxygen concentrations.

The State temperature criteria for salmonid spawning that applies to the lower portion of the watershed is a year-round water temperature of 13°C or less with a daily average no greater than 9°C (refer to table 8). The applicable State temperature criteria for the upper watershed that has an aquatic life beneficial use of cold water biota is a water temperature of 22°C or less with a daily average no greater than 19°C.

Stream temperatures measured within Jim Ford Creek often exceed current water criteria during the low flow period of the year. Between June and October 1998, temperature readings were taken every 1.6 hours at 9 sites within the watershed (see Figure G-2 in Appendix G). Temperature readings were also taken at a spring near the headwaters of Wilson Creek between August and October. Temperature criteria were exceeded at sites except for Site 8, Wilson Creek and Site 9, Wilson Creek headwater spring. Both daily average and daily maximum cold water biota and salmonid spawning temperature criteria were exceeded below the waterfall. Daily average and daily maximum cold water biota temperature criteria were exceeded above the falls. Generally, temperatures were exceeded beginning in early July and persisting to mid-August.

Results of the CWE assessment indicated insufficient canopy cover to maintain stream temperatures within the target in the lower watershed. In addition to noting the contribution of thermal loading from the upper watershed, the following are observations from the CWE report regarding this adverse condition in the lower watershed (IDL 1999 and Appendix C):

“The lower reach flows through an east-west trending basalt canyon such that during the summer substantial heat builds up resulting in considerable long-wave radiation being emitted from all surfaces which can be adsorbed by the water. The stream channel itself is a rather broad, cobble to boulder bed resulting from episodic high flows. During the

summer when flows are low, the stream channel is often through the middle of the unshaded and heat absorbing portions of the bed. Stream shading and, therefore, temperature control has been reduced throughout the Jim Ford Creek watershed, certainly in areas converted to agriculture/grazing, and probably in forested areas as well."

2.2.3.3 Nutrients/Dissolved Oxygen

Nuisance aquatic growth can adversely impact aquatic life and recreation. Algae of various types grow in the water and on the bed of Jim Ford Creek. Algae provide a food source for many aquatic insects, which in turn serve as food for fish. Algae grow where sufficient nutrients (nitrogen and phosphorus) are available to support growth. Flows, temperatures, and sunlight penetration into the water all must combine with nutrient availability to produce conditions suitable for photosynthetic growth. When nutrients exceed the quantities needed to support primary productivity, algae blooms may develop. Death and decomposition of algae creates an oxygen demand. If the demand is high enough because of an algae bloom, dissolved oxygen (DO) concentrations in the water body may decline to low levels that harm fish. Algae blooms and excessive rooted aquatic macrophytes can physically interfere with swimming and wading. Also, decomposing algae can create objectionable odors and some species may produce toxins that could impair agricultural water supply.

Idaho's standard for nutrients states: "Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses (IDAPA 16.01.02.200.06)." Nutrient limitation occurs when a nutrient, usually phosphorus or nitrogen, is below the levels needed for growth in the water column. Influxes of these nutrients will stimulate algal growth if other factors are conducive to growth (light, temperature, flow). Alternatively, a system can have high enough levels of nutrients that it is not limited by nutrients. In that case it is limited by other factors, and nutrient levels must be decreased to levels where they are limiting.

For prevention of plant nuisances, levels of total phosphorus in a stream should not exceed 0.10 mg/L (U.S. EPA 1986). Total phosphorus levels within Jim Ford Creek and its tributaries during 1998 ranged from below detection to 0.18 mg/L (upstream of Weippe). Effluent entering from Timberline High School ranged from 0.36 to 3.30 mg/L, and from the Weippe wastewater treatment plant from 0.68 to 1.30 mg/L. These levels can be conducive to algae growth if there is a phosphorus limiting situation.

Bauer and Burton (1993) indicate that for prevention of plant nuisances a stream should not exceed 0.30 mg/L nitrate. Nitrite/nitrate levels in the creek ranged from nondetect to 0.89 mg/L (downstream at Weippe). Discharge from Timberline High School WWTP ranged from 0.07 to 0.83 mg/L, and from Weippe WWTP ranged from 0.01 to 0.62 mg/L. Discharges from both facilities and downstream of Weippe are at levels that can stimulate algal growth if the system is nitrogen limited.

Increased nitrate levels appear downstream during high flow. Nitrogen/phosphorus ratios in this system are very low (under 15:1). Average nitrite/nitrate increases from the prairie to downstream, while phosphorus levels in the Creek remain relatively uniform. Grazing and livestock presence on the prairie adds nitrogen to the system. Nitrogen is elevated during high flows, appearing to wash in from the prairie during flow events. Total phosphorus does not seem dependent upon flow. Phosphorus levels can increase during low flow times because of release from and cycling within the sediments.

Limited sampling was conducted in 1998 to evaluate the relationship between phosphorus in the dissolved (orthophosphate) and particulate form. Limited samples were collected in May and June from the Weippe WWTP discharge, upstream of the Weippe, and at the mouth. For samples taken at site 3 upstream of Weippe, orthophosphate levels averaged 25% of total phosphorus levels; for samples taken at site 1 at the mouth, this average was 40%; and for samples collected of the Weippe WWTP discharge, this average was 73%. This follows the general pattern of higher dissolved than particulate phosphorus in wastewater treatment effluent and higher particulate than dissolved phosphorus in areas where erosion is occurring.

Algae growths were observed and samples were collected at sites in the upper portions of the watershed in summer 1998. Single cell green algae blooms were noted near the cemetery (site 10 Heywood) and above and below Timberline High School WWTP on Grasshopper Creek. A single cell bloom can indicate nutrient influx. Filamentous green algae Chlorophyta Spirogyra has been identified at the mouth of Winters Creek, upstream and downstream of Weippe, and the mouth of Grasshopper Creek. Spirogyra is a known polluted water alga (American Public Health Association et al. 1975). At these sites the presence of filamentous green algae can indicate long term nitrogen levels high enough to support filamentous algae growth.

Single cell algal colonies (usually resembling brown precipitate in color) can indicate high levels of phosphorus (Owen 1998). The colonies break down excess organic matter. Brown precipitate was noted downstream of Weippe and at the mouth of Grasshopper Creek. At the mouth the precipitate has been identified as colonies of microflagellates and diatoms.

Limited dissolved oxygen data are available for Jim Ford Creek, and trend data are lacking. Low levels (2.4 mg/L) were measured in August 1998 at the site downstream of the Weippe WWTP. Most of the data were collected during daylight hours when photosynthesis is occurring. Diurnal sampling in August 1999 at the upstream and downstream of Weippe locations indicated that dissolved oxygen levels goes well below the State criteria during early morning hours when plant respiration is at a maximum. Decreased oxygen levels in this stream appear to be dependent upon excessive nutrient loading and consequent algal growth (increased biological oxygen demand). It is probable that if nutrient levels and resultant excessive algae growth is addressed, oxygen levels will remain in a healthy range.

2.2.3.4 Pathogens

Pathogens are a small subset of microorganisms (e.g. certain bacteria, viruses, and protozoa) which, if taken into the body through contaminated water or food, can cause sickness or even death. Some pathogens are also able to cause illness by entering the body through abrasions in the skin.

Direct measurement of pathogen levels in surface water is difficult because they usually occur in low numbers and analysis methods are expensive. Consequently, non-pathogenic bacteria which are often associated with pathogens, but which typically occur in higher concentrations, are usually measured. Fecal coliform bacteria are a commonly used indicator organism, although they are not pathogenic themselves in most instances. Fecal coliforms grow in the intestinal tract of warm blooded animals, so their presence indicates recent fecal contamination either from animals or humans. Fecal coliform counts typically increase in response to storm and runoff events. Fecal coliforms survive for long periods in cow feces (up to year); therefore, bacterial numbers may be influenced by past activities. Bottom sediments are a significant reservoir for fecal coliforms that may be resuspended by streamflow or animal disturbance.

1998 data indicated exceedances of the monthly mean standard for primary contact recreation occurred at near the mouths of Grasshopper, Heywood, Miles, and Winter Creeks and on the mainstem of Jim Ford Creek upstream above Weippe during the summer months. Samples collected during the recreation season (May - September) in 1997 showed numerous exceedances of State water quality criteria for primary contact recreation in portions of Jim Ford Creek above the hydroplant and at upstream and downstream locations on Grasshopper Creek. Correlations between 1997 precipitation and fecal coliform measurements indicate that surface runoff and re-suspension of bacteria play a large role in the concentrations measured.

Sampling of the Weippe and Timberline High School WWTP effluent in 1998 did not indicate exceedances of the primary or secondary contact criteria in the discharge samples. No exceedance of criteria occurred on Grasshopper Creek below the Timberline High School WWTP discharge; however, two exceedances of the instantaneous standard occurred downstream of the Weippe WWTP in May and June.

IDEQ is conducting a negotiated rulemaking process that would change the primary and secondary contact recreation standard based on fecal coliform to one based on *E. coli*. Therefore, *E. coli* bacteria were also sampled during the low flow season of 1998. *E-coli* levels correlated well with fecal coliform levels in terms of occurrences and sampling locations with elevated concentrations. Exceedances of the proposed *E-coli* criteria occurred in the same areas where fecal coliform criteria were exceeded--upstream of the hydroplant on the mainstem of Jim Ford Creek and the Winter, Miles, and Heywood Creek tributaries.

2.2.3.5 Ammonia

Ammonia can be both toxic to aquatic animal life and a source of nutrients to plants. Ammonia exists in equilibrium in water in three different forms: dissolved ammonia gas commonly referred to as un-ionized ammonia (NH_3); ammonium hydroxide (NH_4OH); and ammonium ion (NH_4^+). The proportions of these forms in water are dependent upon pH and temperature. As pH and temperature increase, the percentage of total ammonia that exists as unionized ammonia increases, which is the principal toxic form of ammonia. Much of the ammonia present in water bodies is generated by bacteria as an end product in the anaerobic decomposition of organic matter. Ammonia is also an oxygen-demanding substance. Oxygen is consumed when bacteria convert ammonia to nitrate (NO_3) through the process of nitrification.

Idaho water quality criteria for ammonia are intended to protect cold water biota and salmonid spawning. These criteria are the same and are based on calculations that take into account water temperature and pH. No numeric criteria are available in Idaho rules related to the "nutrient" effect of ammonia, i.e. excess concentrations that cause nuisance aquatic growth that impair beneficial uses.

Total ammonia levels in weekly grab samples taken at various creek locations in 1998 ranged from below the detection limit of 0.005 mg/L to 0.231 mg/L and averaged 0.024 mg/L. For comparison to state water quality criteria, the levels in creek samples were initially compared to a conservative target of 0.083 mg/L, which is the state 4-day average total ammonia standard specified for a temperature of 28 °C and pH of 9.0. It is also very close to the criteria established by U.S. EPA for salmonids of 0.083 mg/L (U.S. EPA 1986). Ten of 225 samples have levels that exceeded this conservative target.

These ten samples were then compared to the applicable criteria based on actual or estimated pH and temperature that occurred on the sample collection data. Results are provided in Table 14. None of the levels exceeded the state criteria either based on actual or conservative estimates for pH and temperature. All but one of the samples had levels an order of magnitude below the standard. Based on these results, a TMDL for ammonia based on its toxicity effects is not needed. The nutrient effects of ammonia will be considered in the nutrient TMDL.

For all the 1998 creek sampling locations and dates, none of the ammonia levels exceeded criteria. Ammonia levels upstream of the Timberline discharge tended to be higher than downstream levels; levels downstream of the Weippe WWTP discharge tended to be higher than levels upstream of it. Because the ammonia levels in the creek samples do not exceed State water quality criteria, no TMDL loading analysis, reductions, or allocations are being developed for ammonia based on its toxicity effect.

No numeric criteria are available in Idaho rules related to the "nutrient" effect of ammonia - excess concentrations that cause nuisance aquatic growths that impair beneficial uses. The nutrient effect of ammonia was evaluated as part of the nutrient TMDL (Section 3.3).

Table 14. Comparison of Ammonia Levels to State Criteria

Sample Date	Sample Location	Ammonia, mg/L	pH ¹	Temp. (°C) ¹	Ammonia Criteria, (mg/L)
12/29/97	Site 2 Below Weippe	0.091	NA	18	1.7
2/3/98	Site 2 Below Weippe	0.135	7.8	18	1.5
2/09/98	Site 2 Below Weippe	0.093	7.1	18	1.7
2/11/98	Site 2 Below Weippe	0.163	7.7	18	1.5
2/17/98	Site 2 Below Weippe	0.143	8.4	18	0.45
2/18/98	Site 3 Above Weippe	0.125	NA	18	1.7
5/12/98	Site 2 Below Weippe	0.112	6.5	24	1.13
8/11/98	Site 3 Above Weippe	0.089	NA	24	1.13
9/22/98	Site 2 Below Weippe	0.231	6.8	24	1.13
9/29/98	Site 2 Below Weippe	0.088	6.6	24	1.13

¹ For estimated temperature in December - April, a conservative temperature of 18° C was used for criteria evaluation. This is conservative for wintertime temperatures based on 1998 thermograph data indicated an average daily temperature of 15° C at the site upstream of the hydrodam below Weippe. For the estimated temperature on the date between May and October, a conservative temperature of 24° C observed was used for criteria evaluation. When pH data was not available (NA), a pH of 7.0 was assumed.

2.2.3.6 Oil and Grease

It is unclear why oil and grease was identified on the §303(d) lists as a pollutant of concern for Jim Ford Creek. No historical oil and grease sampling data are available to indicate impairment of beneficial uses due to surface water contamination with oil and grease. Potential sources of oil and grease in the watershed include runoff from agricultural areas, mill facilities, and urban areas within the vicinity of Weippe and discharge from the Timberline High School and Weippe WWTPs.

Idaho water quality criteria indicate that oil and grease concentrations must be less than those found to impair beneficial uses. U.S. EPA water quality criteria (U.S. EPA 1986) for oil and grease for aquatic life are: 1) levels established based on toxicity tests; 2) levels of oil or petrochemicals in the sediment which cause deleterious effects to biota; and 3) surface waters virtually free from floating non-petroleum oils of vegetable or animal origin, as well as petroleum-derived oils. Oils of any kind can have deleterious effects on fish and benthic life by preventing respiration and increasing biochemical oxygen demand. Waste discharge permits issued under U.S. EPA's NPDES program have specified "no visible discharge" of oil and grease is permitted. Within Washington State, log yard storm water NPDES permits have specified that

runoff must not contain oil and grease in concentrations greater than 10 mg/L. The State of Wyoming has an established water quality standard of 10 mg/L for oil and grease.

Table 15 presents oil and grease sampling results from limited locations in 1998. All samples were collected and analyzed following accepted protocols. Samples were located in areas most likely to have oil and grease from storm water runoff as well as general creek conditions. Samples were collected above and below the Weippe WWTP, from the Weippe WWTP discharge, within and below the Hutchins Lumber, Inc., and at the mouths of Grasshopper, Winter and Jim Ford Creeks. All samples had levels below the detection level of 4 mg/L.

Table 15. 1998 Oil and Grease Sampling Results

Sample Location and Date	Oil and Grease, mg/L	Sample Location and Date	Oil and Grease, mg/L
Down gradient of Hutchins Lumber, Inc. 4/13/98	< 4 mg/L	Upstream of Weippe WWTP - 4/13/98	< 4 mg/L
Hutchins Lumber, Inc. at Settling Pond - 5/19/98	< 4 mg/L	Mouth of Jim Ford Creek - 1/27/98	< 4 mg/L
Hutchins Lumber, Inc. 1 at SW end of log yard - 5/19/98	< 4 mg/L	Downstream of Weippe WWTP - 3/9/98	< 4 mg/L
Weippe WWTP - 3/9/98	< 4 mg/L	Downstream of Weippe WWTP - 1/27/98	< 4 mg/L
Weippe WWTP - 4/13/98	< 4 mg/L	Winters Creek - 4/13/98	< 4 mg/L
Upstream of Weippe WWTP - 1/27/98	< 4 mg/L	Grasshopper Creek - 1/27/98	< 4 mg/L
Upstream of Weippe WWTP - 3/9/98	< 4 mg/L	Grasshopper Creek - 3/9/98	< 4 mg/L
		Grasshopper Creek - 4/13/98	< 4 mg/L

Oil and grease is a general measure of pollution from petroleum compounds. Petroleum releases to surface waters are typically detected visually as an oily sheen on the water surface. Sources of

petroleum pollutants can be readily determined and common methods exist to contain and eliminate these releases. Also, the current regulatory framework provided through the NPDES storm water runoff requirements, NPDES wastewater discharge permit requirements, and State of Idaho water quality standards provide legal recourse should oil and grease be found to be impacting beneficial uses in the watershed. Given the sampling results that indicated non-detectable levels of oil and grease and that this pollutant can be readily identified and treated when a release occurs to surface waters and that a regulatory framework exists to address impacts to beneficial uses from oil and grease, no TMDL loading analysis, reductions, or allocations will be developed for oil and grease.

2.2.3.7 Summary of Water Quality Conditions

Results of recent sampling efforts and other information indicate that high temperatures and excessive levels of bedload sediment, nutrients, and bacteria occur in the Jim Ford Creek watershed that have caused exceedances of State water quality criteria and impairment of aquatic life and recreation beneficial uses. Ammonia levels do not exceed State criteria based on toxicity; consequently, a TMDL will not be conducted based on its toxicity effects. The nutrient effect of ammonia will be addressed in the nutrient TMDL. Oil and grease levels do not exceed state criteria; consequently, a loading analysis will not be conducted for this pollutant. Suspended sediment and turbidity levels do not occur at levels demonstrated to cause impairment. Results of 1999 channel stability and habitat survey indicate excess cobble size bed material is likely impairing cold water biota and salmonid spawning beneficial uses in the lower watershed. High temperatures are widespread throughout the watershed, but have the greatest impact in the lower portion of the watershed where salmonid spawning occurs. Bacteria and nutrient levels were highest in the upper watershed.

2.2.3.8 TMDL Data Gaps

This assessment has identified several data gaps that limit full assessment of the effects of §303(d) listed pollutants on beneficial uses as outlined in Table 16. As part of the TMDL implementation phase, a long-term monitoring plan will be developed to address these data gaps. Data limitations are also indicated in the TMDL loading analyses (Sections 3.1-3.4).

Table 16. Data Gaps

Pollutant or Other Factor	Data Gap
Flow	flow data at upstream site is lacking; continuous flow data desired at mouth
	ground water flow data
Fish	fish data to ascertain status of salmonid spawning
Sediment	bedload and channel substrate data to establish trends over time
	pool frequency and residual pool volume data in lower reaches to establish trends over time
	substrate and water column particle size data in lower reaches
	channel cross sections in lower reaches
Temperature	data at the mouth of every tributary during critical periods over time to establish trends
	data to evaluate correlation between water and air temperatures
	ground water temp data
	more detailed vegetative cover data
Nutrients/Dissolved Oxygen	algae data and associated dissolved oxygen and chlorophyll <i>a</i> data
	data on algae growing season
	intergravel dissolved oxygen data
	nutrient data to distinguish various nonpoint sources
	analysis of nutrient storage and release in sediments
	background nutrient level data
	long term monitoring of flow, nutrients and dissolved oxygen at mouth, upstream of Weippe, downstream of Weippe and confluence of Miles and Heywood Creek
Pathogens	<i>E. coli</i> data at mouths of tributaries to establish trends over time
	<i>E. coli</i> data and modeling analyses to differentiate loading from various nonpoint sources

2.3 Pollutant Source Inventory

This section summarizes point source and nonpoint sources of pollutants in the Jim Ford Creek watershed that are impacting beneficial uses. It incorporates information from 1998 and 1999 sampling studies regarding major contributors of loading of pollutant loading to the creek.

2.3.1 Nonpoint Sources

Identified nonpoint sources in the Jim Ford Creek watershed at this time are non-irrigated cropland, grazing, timber harvest, urban runoff, hydropower, septic systems, land development activities, recreation and mining. Agricultural related nonpoint source pollution is caused by conventional tillage practices and livestock feeding operations. Forestry related nonpoint source pollution is caused by forest roads, skid trails, stream crossings, and loss of stream shade within riparian areas during harvest activities. Potential impacts to water quality on forested state endowment and private land in the Jim Ford Creek watershed also stem from livestock grazing. Storm water related nonpoint pollution is caused by construction activities, resident and business activities, roadways, and parking lots. Hydropower related nonpoint pollution within Jim Ford Creek includes erosion adjacent to conduit pipes during pipe rupture events, and a reduction in flow and dilution within the bypass reach.

There are a few gravel pits located within the Jim Ford Creek watershed. This type of industrial activity is regulated under the U.S. EPA's NPDES Storm Water Program. These sites currently do not have NPDES permits. Under the Draft National Storm Water Discharge Multi-Sector Permit, discharge from these sites may have discharge restrictions or Best Management Practice (BMP) requirements. Because these sites are not currently managed under the U.S. EPA's Storm Water Program the pollutant loads and allocations have been grouped with nonpoint storm water discharge activities. Recreational uses in the subbasin can contribute to erosion and sedimentation. Road construction and maintenance (e.g. road sanding) and landslides associated with road cut and fill slopes also contribute to erosion and sedimentation.

2.3.2 Point Sources

Point sources currently managed under the NPDES program are two wastewater treatment plants and a lumber mill. The Weippe WWTP (Permit Number ID-0020354) is located along Jim Ford Creek at the confluence with Grasshopper Creek. The Timberline High School WWTP (Permit Number ID-0023914) is located along Grasshopper Creek, about 6 miles north of Weippe. Another point source within the Jim Ford Creek watershed is the storm water runoff from Hutchins Lumber, Inc. For purpose of determining loads and allocations, runoff from this facility has been grouped with nonpoint source storm water discharge activities.

2.3.3 Pollutant Specific Sources

This section indicates how nonpoint sources and point sources contribute to specific pollutant

loads in the Jim Ford Creek watershed. Table 17 summarizes pollutant specific sources.

2.3.3.1. Sediment

Sediment enters Jim Ford Creek and its tributaries largely from nonpoint sources. Although the 2 WWTPs are permitted to discharge total suspended solids, the permitted levels and the actual measured levels in the discharges of both plants are considered to be low and do not impact beneficial uses. Sediment sources along Jim Ford Creek and its tributaries include agricultural runoff, forest road activities, failures and surface erosion from conduit failures at the hydropower plant, unstable streambanks, runoff from the City of Weippe, and runoff from highway district and county roads. Sources of fine sediment adjacent to Jim Ford Creek and its tributaries appear to be concentrated within the Weippe Prairie and within the granitic, forested areas in the eastern portion of the watershed. The channel substrates within the Weippe Prairie and within the northern and eastern portions of the watershed were found to have numerous deposits of fine sediment. Excess coarse-size sediments in the lower watershed appear to be the type of sediment that impairs beneficial uses. Sources of this coarse sediment in the lower watershed include mass failures, which can be caused by management activities or natural events, in-channel erosion, and streambank erosion.

2.3.3.2 Temperature

Stream temperature in the Jim Ford Creek watershed is regulated by climate, elevation and solar radiation. Thermal loading from the WWTPs is limited, and discharge does not typically occur in the critical time period. Management activities including timber harvest in proximity of the stream, grazing in riparian areas, channelization, and alteration of total vegetative cover have contributed to increased solar radiation entering the stream. Excess sediment supplied to the channel has increased bedload, and resulted in a wider, shallower channel. This has increased the surface area of water exposed to solar radiation and heat absorption by the stream. Channelization of the stream associated with land use activities in the upper watershed has resulted in increased flow velocities, and channel downcutting leading to additional sediment loading and bank erosion.

2.3.3.3 Nutrients/Dissolved Oxygen

Sources of nutrients (e.g. nitrate, nitrite, ammonia, and phosphorus) within the Jim Ford Creek include both point and nonpoint sources. The WWTP discharges contain elevated concentrations of nutrient compounds. The plants do not discharge during the low flow season. Nonpoint sources include storm water runoff, animal waste runoff from domestic and agricultural activities, failed septic systems, fertilizer applications and ground water. Also, eroded sediments entering the stream system may have high phosphorous concentrations. The dam above the Ford's Creek hydroplant traps sediment and consequently removes nutrients from the system, especially phosphorus. As noted previously, failed septic systems are not considered to be a contaminant source in the Jim Ford Creek watershed. Nutrients that enter the streams in the

watershed from ground water generally have their source in the same land use activities that contribute nutrients directly to surface water. Although excessive nutrients are a major cause of low dissolved oxygen, excessive levels of sediment and high temperatures also contribute to low dissolved oxygen conditions.

2.3.3.4 Pathogens

The major sources of pathogens in the watershed are nonpoint sources. Although the discharge from the 2 WWTPs contains bacteria, the levels of bacteria in the discharge samples did not exceed State criteria. The Weippe WWTP effluent is chlorinated to control bacteria releases. In urban areas, nonpoint sources of pathogens include urban litter, contaminated refuse, domestic pet and wildlife excrement, and failing sewers lines. No sewer lines are known to be failing in Weippe. Potential nonpoint sources of bacteria in rural areas include grazing operations, failed septic systems, and wildlife. Repairs to septic systems usually occur soon after the problem has been identified. Septic systems in the Jim Ford Creek watershed are not believed to be likely contaminant sources (King 1998). However, further investigation of the contribution of septic systems to pollutant loading is needed. Animals dependent on a stream as a water source often add large amounts of waste to the stream system. Compaction in adjacent areas to the stream has also been found to increase near-bank surface runoff, which in turn carries additional animal wastes into the stream.

Table 17. Summary of Pollutant Sources

Source	Bedload Sediment ²	Temperature	Nutrients/ Dissolved Oxygen	Pathogens
Agriculture/Livestock Grazing		X	X	X
Non-irrigated crops		X	X	
Forestry/Timber Harvest	X	X	X	
Forestry/Livestock Grazing	X	X	X	X
WWTPs			X	X (minor)
Septic Tanks			X	X
Other Roads ¹	X	X	X	
Recreation	X	X	X	
Storm Water		X	X	X
Hydropower	X	X		

¹ Roads other than timber harvest roads

² While fine sediment sources exist in the watershed, sources of excess cobble size bed material are believed to cause impairment of beneficial uses.

2.4 Pollution Control Efforts

Pollution control efforts over the past few years within the Jim Ford Creek watershed have been examined according to land uses and activities. Future pollution control efforts to achieve the required pollutant reductions for TMDL targets will be outlined in a Jim Ford Creek TMDL Implementation Plan. Section 3.0 will address the required reasonable assurance of pollutant reductions from non-point sources.

2.4.1 Nonpoint Pollution Control Efforts

Agriculture: A wide variety of BMPs have been implemented in Clearwater County over the past few years with great success. The No-till conservation system has increased from a mere 2% to 3% five years ago to well over 90% at present. Water and sediment control structures and grassed waterways have continued to reduce overland flow and subsequent gully erosion on cropland. Fencing, livestock access ramps, pasture and hayland management, and proper grazing use are other BMP's used to improve livestock grazing and management.

Prior to 1990, programs available to landowners within the Jim Ford Creek watershed were cost-share incentives through the Farm Service Agency's (FSA, formerly the ASCS) Alternative Conservation Program (ACP). These were site specific BMPs aimed at reducing livestock impacts to streams and other water bodies. These BMPs consisted of fencing, ponds, off-site watering systems, and spring developments. Minimal participation occurred within the Jim Ford Creek watershed in conjunction with this program.

During the early 1990's the CWSCD produced a comprehensive watershed management plan for the greater Lolo and Jim Ford Creek watersheds (CWSCD 1993). In the process of preparing the plan, the CWSCD identified and evaluated various nonpoint source pollution control strategies to determine the most feasible alternative. Present and planned activities within this planning document are expected to achieve water quality improvements in a reasonable time frame. Within the Jim Ford Creek watershed, funds were available for the development of the management plan, but funding has not yet been approved for implementation.

Livestock: Currently, no concentrated animal feeding operations (CAFOs) such as feedlots, hog producers, or dairies are within the Jim Ford Creek watershed. However, there are approximately 80 livestock winter feeding operations. The CSWCD conducted an inventory of livestock overwintering and holding facilities throughout Clearwater County in the spring of 1998. The inventory was part of an ongoing effort to remain proactive in the conservation of the area's land and water resources.

An inventory and analysis of all overwintering operations and their roles as potential pollutant contributors to area streams and rivers was a first step toward establishing economically feasible

alternatives that allow livestock operators (both professional and hobby interests) to respond voluntarily to local water quality concerns. Operations in 5 watersheds (Jim Ford Creek included) were inventoried. The resulting study identified which watersheds are at the greatest risk of negatively impacting water quality. In addition, a number of general water quality improvement strategies are presented.

The inventory of the livestock overwintering facilities in the Jim Ford Creek watershed and adjoining tributaries revealed several management considerations that could help reduce potential water quality impacts. Many of these recommended management considerations meet previously established NRCS conservation practices. Many of these conservation practices were not developed with livestock overwintering facilities in mind but adapt very well to that need. Various adaptations and combinations of these practices will provide site specific packages of management recommendations to minimize water quality impacts.

IDL manages livestock grazing on endowment land, and is involved in three separate cooperative grazing allotments in the Jim Ford Creek watershed. Although the Idaho Forest Practices Act FPA and rules adopted pursuant to it do not regulate grazing practices, IDL encourages grazing lessees to apply BMPs on state land and other land, such as Pottlatch, within the cooperative allotments. Common practices include fencing critical areas, rotational pastures, development of water sources and salting areas away from streams, and minimizing forage utilization in riparian areas. Grazing management plans are in effect for each allotment and are reviewed and revised each year as needed to continue an adaptive management strategy to minimize impacts of grazing.

Septic Systems: Homeowners outside the City limits within the watershed rely on individual septic tanks and drain field systems. The North Central District reviewed a number of the waterways in the Weippe area to evaluate the potential for surface water contamination from failure of septic systems (King 1998b). The soils around Weippe are not considered optimum for individual subsurface sewage systems as they have a high clay content as a general rule. However, the density of housing in the rural areas around Weippe is quite low. The dwellings in that area are set back from the waterways an adequate distance such that subsurface sewage systems meet the required setbacks from surface water. One failing system in the past was close enough to a stream to be a problem. That system is believed to have been repaired (King 1998b). The District has no documentation of failing individual subsurface sewage systems that are causing a surface water contamination problem at this time. However, this evaluation was based on limited information and further investigation is needed to ascertain whether septic systems contribute significantly to pollutant loading in the watershed.

Hydropower: Efforts to repair failures and landslides as a result of penstock failures and road failures that occurred in the late 1980's along Jim Ford Creek and to avoid future failures were completed by the Ford Hydro Limited Partnership in 1998. Also, the diversion structure is cleaned out on a regular basis, thus retaining it's ability to remove some of the instream sediment from the upper basin.

Forestry: Application of conservation applications on private forested lands has been accomplished with BMPs applied under the authority of the Idaho Forest Practice Act (FPA), which is administered by IDL. Throughout Clearwater County, increased awareness and action through the FPA, both the State and private landowners have made great strides in improving land resources on timberland. Present timber harvests, road building and maintenance, and livestock grazing management have all shown improvements in overall water quality within the watershed. The CWE Assessment conducted in 1997 and 1998 indicated the only adverse condition for forestry in the Jim Ford Creek watershed to be the lack of shading for reaches of the creek below the falls. This triggers further analysis and/or the development of site-specific BMPs.

IDL manages 23,000 acres of State endowment land in the watershed, most of which is forested. The Department has the charge of managing these lands for revenue to the state endowments using sound long-term management practices. IDL endeavors to meet or exceed the rules of the FPA and BMPs throughout State ownership. Jim Ford Creek was listed as a stream segment of concern (SSOC) under the previous anti-degradation rules, and site-specific BMPs determined by the SSOC process have been implemented since that time.

Endowment land is managed by professional foresters using sound land management practices, silvicultural methods, and road engineering techniques. Examples of BMPs applied on State land in the watershed are managing stream protection zones, properly locating and constructing needed roads to minimize erosion including proper drainage, spot rocking, or graveling road surfaces, cross-ditching or rolling dip construction, grass seeding and mulching. Old roads that are improperly located too close to riparian areas are relocated, abandoned, or obliterated. IDL initiates road closures that barricade unsurfaced logging roads after use to prevent road damage and erosion, and gate many main roads seasonally to restrict general traffic during wet or adverse conditions. IDL also has a deferred maintenance program to repair damaged roads or drainage structures annually as they become evident. IDL is currently implementing a state wide road inventory system that will be the basis for identifying and prioritizing all future road maintenance needs to ensure water quality objectives are met.

Since the late 1970's, Potlatch Corporation has been following a strict set of harvesting guidelines specifically written to minimize or prevent erosion and sedimentation of streams. The requirements of these guidelines are to meet or exceed the FPA. These guidelines have been updated several times as new technologies developed.

Specific activities by Potlatch within the Jim Ford Creek watershed include: reconstruction of many older roads to meet current criteria; improved drainage structure, water bars, grass seeding, and relocating out of riparian areas; natural dirt roads have been surfaced with gravel and pavement to eliminate road surface erosion; temporary road closure activities with gates and/or berms; and permanent road closure activities. Ongoing planning efforts include ongoing inspection and routine maintenance for areas owned by Potlatch within the Jim Ford Creek watershed.

The NPT has adopted BMP guidelines which are used to develop site-specific BMPs on Tribal forests (NPT 1999). The NPT uses an interdisciplinary approach to land management with input from foresters, hydrologists, fisheries and wildlife biologists, and soil, range, and cultural resource professionals when developing site-specific management plans.

2.4.2 Point Source Control Efforts

Weippe WWTP: The original treatment facilities for the City of Weippe were constructed in the late 1960's. Prior to that time, homeowners were served by individual septic tanks and drain field systems. Currently, every household within the Weippe City limits is connected to the WWTP.

In January of 1981 a Facility Plan for the Weippe's WWTP was completed in order to meet State of Idaho wastewater treatments and effluent discharge limitations requirements. Changes to the system as a result of this plan included construction of wastewater collection system in the Pleasant Acres community, installation of an improved aerator, and installation of new pumps to handle increased flow.

In 1987 the State of Idaho recognized the potential contamination to Jim Ford Creek from the WWTP during the low flow season and recommended NPDES permit requirements allowing a minimum dilution ratio of 50:1 for the effluent discharge (IDEQ 1987). These requirements were specified in a NPDES permit issued June 1988. Subsequently, the City initiated upgrades to its facility in two phases under terms of a compliance order with U.S. EPA.

The first phase of the waste water system upgrade in 1988 was a limited Sewer Evaluation Survey on the sewer main and manholes of the system. Numerous points of infiltration and inflow were identified during the survey. As a result, approximately 115 manholes were replaced and numerous main line holes and shears were repaired.

During the summer of 1991 the second phase to enlarge the holding capacity of the lagoons took place. This phase included enlarging Lagoon No. 1 for a total capacity of 14 million gallons, the installation of floating aerators in Lagoons No. 1 and 2, the construction of a lagoon control building, and the addition of a chlorination system. The enlargement of Lagoon No. 1 resulted in a thinning of the clay seal along the bottom of the lagoon. A leak developed from a fresh water spring at the lagoon bottom. A drainpipe was installed under the lagoon to provide drainage for the spring water. Outflow from the spring, and possibly the wastewater, occurs at a low rate (<0.01 cfs) year round into Grasshopper Creek.

Timberline High School WWTP: The Timberline High School WWTP provides sewage service for approximately 200 students, faculty, and administrators over each school year. The facility received its permit to discharge into Grasshopper Creek, a tributary to Jim Ford Creek, in 1974. In 1991, the facility underwent a series of maintenance and upkeep repairs. The pond's aerator and concrete liner were repaired and accumulated sludge and cattails were removed from

the facultative pond. The sludge tank between the aerator pond and the facultative pond was cleaned out during the summer of 1997.

Hutchins Lumber, Inc.: A Storm Water Pollution Prevention Plan was developed for Hutchins Lumber, Inc. by TerraGraphics in 1997 and revised by Blue Ribbon Environmental, Inc. in 1999. This environmental management plan provided direction for controlling surface water discharge from the mill site through prescribed BMPs. Construction of storm water controls were completed in 1999.

2.4.3 Reasonable Assurance

For watersheds that have a combination of point and nonpoint sources where pollution reduction goals can only be achieved by including some nonpoint source reduction, the TMDL must incorporate reasonable assurance that nonpoint source reductions will be implemented and effective in achieving the load allocation (U.S. EPA, 1991). If appropriate load reductions are not achieved from nonpoint sources through existing regulatory and voluntary programs, then reductions must come from point sources. In the Jim Ford Creek TMDL, reductions from both point sources and nonpoint sources are needed for nutrients.

Nonpoint source reductions listed in the Jim Ford Creek TMDL will be achieved through the combination of authorities the State, NPT and U.S. EPA possesses; on-going efforts to reduce nonpoint pollution; and the commitment of the Jim Ford Creek WAG and other watershed landowners to future nonpoint source pollution control efforts. This section discusses how reasonable assurance is provided both on a programmatic and watershed specific basis for the Jim Ford Creek watershed.

2.4.3.1 Regulatory Authorities for Nonpoint Source Pollution Control

The State, NPT, and U.S. EPA have responsibilities under §§401, 402 and 404 of the CWA to provide water quality certification within this watershed. Under this authority, the State, NPT, and U.S. EPA review dredge and fill, stream channel alteration and NPDES permits to ensure that the proposed actions will meet all water quality standards. These activities are on-going and will continue in the future.

Due to data limitations, storm water runoff is addressed as a nonpoint source pollution in this TMDL. However, U.S. EPA regulates storm water runoff under its NPDES permitting regulations and program. Runoff controls are being implemented at the Hutchins Lumber, Inc. facility under these regulations; these regulations may apply to other facilities in the watershed; however, they do not apply to cities as small as Weippe. The State, NPT, and U.S. EPA provide nonpoint source pollution prevention education and technical assistance/support to cities/counties, and watershed advisory groups throughout the state. Guidance is available from the U.S. EPA, the NPT, and the State on BMPs for storm water runoff controls that includes educational activities, construction site runoff, and on site detention of runoff.

Under §319 of the CWA, each state or tribe is required to develop and submit a nonpoint source management plan. U.S. EPA has approved the current Idaho Nonpoint Source Management Plan (Bauer 1989) as meeting the intent of §319 of the CWA. The Plan identifies programs to achieve implementation of BMPs, includes a schedule for program milestones, and identifies available funding sources. The state attorney general has certified that adequate State authorities exist to implement the Plan. The Idaho Nonpoint Source Management Program coordinates the development and execution of this Plan. The NPT is currently developing its nonpoint source management plan.

Idaho Water Quality Standards and Wastewater Treatment Requirements (IDAPA 16.01.02) refer to existing authorities to control nonpoint pollution sources in Idaho and list designated agencies responsible for reviewing and revising nonpoint source best management practices. Designated agencies are IDL for timber harvest activities, oil and gas exploration and development and mining activities; the ISCC for grazing and agricultural activities on private lands; the Idaho Department of Transportation (IDT) for public road construction; the Department of Agriculture for aquaculture; and IDEQ for all other activities (IDAPA 16.01.02.003). Table 18 lists the existing state rules covering approved best management practices pertinent to existing and possible future nonpoint sources in the Jim Ford Creek watershed. The U.S., through the various agencies including U.S. EPA and NRCS, and the NPT retain authority to control nonpoint pollution problems within the Nez Perce Reservation.

Table 18. Approved BMPs in Idaho Rules

Authority	IDAPA Citation	Responsible Agency
Idaho Forest Practice Rules	16.01.02.350.03(a) or IDAPA 20.02.01	Idaho Department of Lands
Rules Governing Solid Waste Management	16.01.02.350.03(b) or Title 1, Chapter 6	Idaho Department of Health and Welfare
Rules Governing Subsurface and Individual Sewage Disposal Systems	16.01.02.350.0(c) or Title 1, Chapter 3	Idaho Department of Health and Welfare
Rules and Standards for Stream-Channel Alteration	16.01.02.350.03(d)	Idaho Department of Water Resources
Rules Governing Exploration and Surface Mining Operations in Idaho	16.01.02.350.03(f)	Idaho Department of Lands
Rules Governing Placer and Dredge Mining in Idaho	16.01.02.350.03(g)	Idaho Department of Lands
Rules Governing Dairy Waste	16.01.02.350.03(h) or IDAPA 02.04.14	Idaho Department of Agriculture

The State of Idaho initially uses a voluntary approach to control agricultural nonpoint sources. However, regulatory authority can be found in the water quality standards (IDAPA 16.01.02.350.01 through 16.01.02.350.03). IDAPA 16.01.02.054.07 refers to the Idaho Agricultural Pollution Abatement Plan (Ag Plan) (ISCC et al. 1993) which provides direction to the agricultural community on approved BMPs. A portion of the Ag Plan outlines responsible agencies or elected groups that will take the lead if nonpoint source pollution problems need to be addressed. For agricultural activity, it assigns the local soil conservation districts (SCDs) to assist the landowner/operator with developing and implementing BMPs to abate nonpoint pollution associated with the land use. If a voluntary approach does not succeed in abating the pollutant problem, the state may seek various administrative and civil remedies, including without limitation injunctive relief, for those situations that may be determined to be an imminent and substantial danger to public health or environment (IDAPA 16.01.02.350.02.a and b).

The Idaho water quality rules also specify if water quality monitoring indicates that water quality standards are not being met, even with the use of BMPs or knowledgeable and reasonable practices, the state may request that the designated agency evaluate and/or modify the BMPs to protect beneficial uses. If necessary the state may seek injunctive or other administrative or judicial relief against the operator of a nonpoint source activity in accordance with the Director of the Department of Health and Welfare's authority provided in §§39-108, Idaho Code (IDAPA 16.01.02.350).

2.4.3.2 On-Going Activities

Past efforts to implement BMPs are summarized in section 2.4.1. This section highlights on-going activities to implement BMPs.

Agricultural Land Uses: The CSWCD applied for and received funding for implementation projects in the Jim Ford Creek and Big Creek watersheds under the Environmental Quality Incentives Program (EQIP). Efforts in the first year (fall 1999) will concentrate on planning and promoting the 6 year project. The funding is geared for agricultural projects. The area to be treated with EQIP contracts is estimated to be 75% of the non-federal and tribal acres without the urban land and most of the forested areas, or about 11,700 acres in both the Jim Ford Creek and Big Creek watersheds. Goals of the EQIP project will be:

- To control erosion and trap sediment with crop residue management, permanent vegetative plantings, and maintenance of stream buffers and filter areas.
- To lower or modify water temperatures and stream recharge by improving upland vegetative cover in the watershed, improving infiltration rates of soil water, providing multi layer shading along stream buffers, water spreading in meadows, constructing wetlands, and other ways to flatten the stream hydrograph.
- To apply comprehensive nutrient management plans with landowners and remove nutrients through controlled harvesting or grazing.

- To reduce bacteria in surface water by eliminating direct discharges from sources, by constructing wetlands, improving filter areas and buffers, and better distribution of livestock.

Forestry Land Uses: IDL implements the FPA and the rules pertaining to the FPA (IDAPA 20.02.01) that apply to State and private forestry activities in the watershed. The rules identify BMPs that apply to any single instance of timber harvesting, reforestation, road construction and maintenance, chemical application, or slashing management. Additional BMPs apply to practices bordering water quality limited streams such as Jim Ford Creek and cumulative watershed effects are considered as described in Section 2.2.2.3 and Appendix C. The NPT follows forest practice guidelines on reservation lands, as described in the NPT Management Plan (1999). These guidelines apply to all aspects of forest management including those mentioned above. In these ways, BMP implementation is ongoing in forested areas of the watershed.

2.4.3.3 Jim Ford Creek Implementation Plan

The Idaho Water Quality Standards directs appointed watershed advisory groups to recommend specific action needed to control point and nonpoint sources affecting water quality limited waterbodies. Upon issuance of this TMDL, the Jim Ford Creek WAG, with the assistance of appropriate federal, State, and tribal agencies, will begin development of an implementation plan. The Jim Ford Creek watershed restoration strategy (Appendix H) provides the framework for the implementation plan. It lists the types of best management practices the WAG believes will best improve water quality and the locations where these practices can reasonably be expected to be applied. The restoration strategy focuses on reduction of thermal load, sediment, bacteria, and nutrients.

The implementation plan will provide details of the actions needed to achieve load reductions, a schedule of those actions, and specific monitoring needed to document action and progress toward meeting water quality standards.

The implementation plan:

- Bases pollutant control actions on the load allocations in the TMDL;
- Sets a time by which water quality standards are expected to be met, including interim goals or milestones as deemed appropriate;
- Schedules the what, where, and when of actions that are to take place;
- Identifies who will be responsible for undertaking planned actions;
- Specifies how completion of actions will be tracked;

- Includes a follow-up monitoring plan to address data gaps, and how data will be evaluated and used to recommend revisions to the TMDL; and
- Describes monitoring to document attainment of water quality standards, including evaluation and reporting of results. This monitoring will evaluate both BMP effectiveness and applications.

2.4.3.4 Potential Funding Sources

Table 19 provides a summary of the types of funding sources available for control of nonpoint pollution sources. Some of these funding sources have been used for past projects. The Jim Ford Creek WAG and the TMDL implementing agencies are committed to seeking funding for water quality improvement projects from these funding sources as well as other new funding sources that become available.

Table 19. Potential Sources of Funding for Non point Source Control Activities

Type of Program	Lead Agency	Land Use Coverage	Typical Cost Share
Federal Programs			
Public Law 566	NRCS	Cropland, Pasture, Riparian, Range	65%
Environmental Quality Incentives Program (EQIP)	NRCS	Cropland, Pasture, Riparian, Range	75%
Wildlife Incentives Program	NRCS	Wildlife Habitat Improvements	75%
Forestry Incentives Program	NRCS	Timber Planting, Reforestation, Forest Roads	50-75%
Conservation Reserve Program (CRP)	FSA	Cropland, Reforestation	50% + rental based on soil type
Continuous CRP	FSA	Grassed waterways Filter/buffer strips, Riparian Forest Buffer Strips	50% + rental based on soil type + 20% incentive
Wetlands Reserve	NRCS	Cropland	easement for protecting wetlands
Resource Conservation & Development	NRCS	Land Conservation, Water Mgt. Community Development	requires funding sources based on specific project

Type of Program	Lead Agency	Land Use Coverage	Typical Cost Share
319	U.S. EPA/IDEQ	Cropland, Riparian, Rangeland, Forest Roads, Urban Areas	prioritized through BAGS/WAGS recommendations
State Programs			
Habitat Improvement Program	IDFG	Upland Habitat Improvements	50%-75%
Resource Conservation & Rangeland Development	ISCC	Riparian, Rangeland, Cropland	low interest loans and grants
State Income Tax Credit	ISCC	Riparian, Rangeland, Cropland	50% \$2,000 max. state tax credit/yr upon prior approval
State Agricultural Water Quality Project	ISCC	Riparian, Rangeland, Cropland	up to 90%
Other			
Bonneville Power Administration	FOCUS ISCC/NPT	Aquatic, Riparian, Upland Restoration	variable
U.S. Fish & Wildlife Service (USFWS)	USFWS	Wetland/Riparian Improvements	unknown
National Marine Fisheries Service (NMFS)	NMFS	Wetland/Riparian/Instream Improvements	50% in-kind non-federal match
Army Corps of Engineers (ACOE)	ACOE	Instream to Enhance Wildlife/Protect Resources	unknown

NPT = Nez Perce Tribe

NRCS = Natural Resources Conservation Service

FSA = Farm Services Agency

U.S. EPA = U.S. Environmental Protection Agency

IDEQ = Division of Environmental Quality

IDFG - Idaho Dept of Fish & Game

ISCC = Idaho Soil Conservation Commission

3.0 JIM FORD CREEK LOADING ANALYSES AND ALLOCATIONS

Jim Ford Creek is listed on Idaho's 1994, 1996, and 1998 §303(d) for these pollutants of concern: sediment; nutrients; temperature; dissolved oxygen; oil and grease; pathogens; and ammonia. Grasshopper Creek is listed on Idaho's 1994, 1996, and 1998 §303(d) lists for nutrients, sediment, temperature, and pathogens. Pollutant targets, loads, load capacities, and load allocations are presented for sediment, temperature, nutrients, dissolved oxygen, and pathogens for these two creeks in this section. Section 2.2.3 provides justification on why loading analyses are not necessary for oil and grease and ammonia.

Flow and habitat are identified on the §303(d) list as impairing uses in Jim Ford and Grasshopper Creeks. Flow and habitat do not let themselves to mass/time pollutant loading as defined by U.S. EPA guidance on TMDL development. The Jim Ford Creek TMDL does not address flow and habitat issues because these parameters are not currently required to be addressed under §303(d) of the Clean Water Act. If the U.S. EPA determines that TMDLs are required for water quality problems caused by flow and habitat modification, TMDLs will be developed. Flow and habitat modifications may be addressed through activities needed to implement TMDLs for other listed parameters.

Loading capacity is effectively synonymous with the TMDL for a water body. TMDL is defined as mass per unit time (e.g. pounds per day) of pollutant allowed. The TMDL is the amount of pollutant that can enter the creek without exceeding water quality standards. Although the TMDL is defined in pounds per day or equivalent measurement, in practice, compliance is measured as a concentration of pollutant in the creek (the water quality target) usually expressed in mg/L.

In a conventional approach to TMDLs there are two basic steps to loading analysis: 1) determining or predicting existing loads, and 2) determining the load capacity. The difference of the two provides the necessary load reductions that need to be achieved in order to meet water quality standards. Most simply, load is a product of a concentration and flow data. Existing loads can be calculated directly from instream concentration and flow data, but often need to be estimated for flows or times other than those monitored. Load capacity is similarly calculated, but with a water quality criteria or concentration target instead of instream concentrations and flows based on the critical loading condition. While this sounds simple, it often does not work out so simply and unconventional approaches are often needed to some degree mainly due to data limitations.

Wasteload allocations (WLA) are established for point sources and load allocations (LA) are determined for other sources. Load allocations are best estimates of the portion of the total load that can be contributed by nonpoint sources or by natural sources. When uncertainty exists about the pollutant to water quality relationship (this is almost always the case), federal law requires a margin of safety (MOS) be included in the calculations. The MOS may be explicitly incorporated into the TMDL or may be incorporated in conservative assumptions used to

establish the TMDL. The MOS is intended to insure that water quality goals will be met even though uncertainty in the loading capacity exists. The TMDL is the sum of the individual waste load allocations for point sources (WLA), the load allocation for nonpoint sources and natural background (LA) plus a margin of safety.

In the TMDLs developed for Jim Ford and Grasshopper Creeks, pollutant targets are based on numeric water quality standards where they exist, or interpretation of narrative water quality standards in the case of nutrients and sediment. Pollutant load allocations are presented as a function of available flow and allowable pollutant concentration based on the pollutant targets. Where the point sources and non-point sources contribute to loading of the same pollutant, the estimated load capacity is divided among the point sources and nonpoint sources. The source, quality and quantity of data used in determining each pollutant target, load, and allocation is discussed in relation to each pollutant within the following sections.

An implementation plan will be developed by the Jim Ford Creek WAG and supporting agencies to specify controls designed to improve water quality in the Jim Ford Creek watershed by meeting the load allocations contained in this TMDL document. During implementation, additional water quality information is expected to be generated. This information may indicate that targets, load capacities, and load allocations may need to be changed. In the event that data show changes are warranted, TMDL revisions will be made with assistance from the Jim Ford Creek WAG. Because the targets, load capacity, and allocations will be re-examined and potentially revised in the future, the Jim Ford Creek watershed TMDL is considered to be a phased TMDL.

3.1 Sediment

This section describes the Jim Ford Creek coarse sediment TMDL components. The sediment targets and load capacity, load analysis and allocation, and margin of safety and critical conditions are described below. For simplicity, the technical details of the analyses are not included in this section and are provided in Appendix F.

3.1.1 Sediment Targets and Load Capacity

This section describes the Jim Ford Creek TAG's interpretation of the State of Idaho narrative sediment standard (IDAPA 16.01.02.200.08), and the linkage between the sediment targets and load capacity. As explained in Section 2.2.3.1.1 (pg. 2-41), fine sediment is not a problem, and data indicate that Jim Ford Creek meets the numeric turbidity standard. The narrative sediment standard states that sediment must not be present at levels which impairs beneficial uses.

Given the available climatic, geomorphic, and water quality data, it is likely that anthropogenic water and sediment inputs to Jim Ford Creek have destabilized lower gradient reaches to a point above what is expected naturally. All the measures of channel stability, aquatic health, and water quality indicate that the balance between water, sediment, and channel geometry are not in dynamic equilibrium, salmonid spawning and rearing habitat is degraded, and summer water temperatures are higher than natural conditions. Therefore, this analysis assumes that channel instability has resulted from management and has caused a widening and shallowing of the stream, and a loss of pools and pool volume. It further assumes that both of these impacts have adversely effected salmonid spawning and coldwater biota uses by significantly reducing critical pool habitat, and increasing the temperature of the stream due to its wide/shallow nature. Data and information collected in the future can be used to revise these assumptions, if warranted.

To address the beneficial use impairments, the coarse sediment TMDL establishes a residual pool volume target and a width/depth ratio target, discussed in greater detail below, which are expected to lead to full support of the salmonid spawning and coldwater biota uses and attainment of the narrative sediment standard. The TMDL targets are established for response reaches. The targets are residual pool volume and bankfull width to depth ratio. Due to a lack of historic information and local reference conditions pertaining to the natural state of lower Jim Ford Creek, the logical alternative is to set sediment targets using regional reference conditions and theoretical thresholds (Montgomery and Buffington 1993). The existing and desired target values are listed in Table 20.

The residual pool volume target is established using the theoretical threshold approach where empirical data are used quantify the existing and desired condition. In theory, stream reaches that are in a semi-stable condition and have adequate pool volume can be used to establish the desired condition. For lower Jim Ford Creek, the average residual pool volume of transport reaches, thought to be in a semi-stable state, is used as the target value. Because pool volume is naturally variable, the target is considered an estimate of potential conditions, and future data will be used

to refine the target value. Residual pool volume data, reported in Appendix E, indicate that the residual pool volume needs to be increased by at least 49% (Table 20). In other words, most of the pools within response reaches are half filled with coarse sediment.

The bankfull width to depth ratio target is established using the NMFS matrix discussed in Appendix E. The matrix values were developed using empirical data from regional reference streams. Much like residual pool volume, the existing bankfull width to depth ratio is established by calculating the average bankfull width to depth ratio for all the inventoried response reaches. Comparing this value to potential reference conditions shows that existing bankfull width to depth ratio needs to be decreased about 56% (Table 20).

Table 20. Sediment Targets for Response Reaches

Target	Existing Value	Desired Value	Percent Change
Mean Residual Pool Volume (Yd ³)	99	196	49
Mean Bankfull W/D ratio	90	< 40	56

Available data are used to establish the location of reaches thought to be critical to the success of salmonid spawning and rearing. These reaches have been used to quantify existing conditions and are where sediment targets will be measured over-time to evaluate TMDL progress. During the TMDL implementation phase, a detailed monitoring plan will be developed which outlines the methods and goals of monitoring: for example, critical reaches should be surveyed using the channel reference site method (Harrelson et al. 1994).

As stated above, the sediment targets are a numerical interpretation of the narrative sediment standard. Because these targets are not traditional mass-per-unit-time loading values, an inferential link between the targets and sediment loading is used to develop the sediment load capacity.

At this time a direct empirical link between the targets and the sediment load capacity cannot be established. As a result, a linkage analysis is completed. A linkage analysis shows how numeric targets and the load analysis results relate to each other, and how they combine to yield estimates of sediment load capacity (EPA, 1999). For lower Jim Ford Creek, the present status of instream sediment targets are a function of the sediment and water inputs, however, there is not a linear relationship between the percent change in the target and sediment load.

This TMDL makes an inferential link between instream sediment targets and bedload transport rates. It assumes that by reducing the bedload transport rate of transport reaches, the stability of response reaches will increase, and by improving the stability of response reaches, the residual pool volume will increase and the bankfull width to depth ratio will decrease. Based on this premise, it follows that by reducing the bedload transport rate by about 95% (see below), the bankfull width to depth ratio and residual pool volume targets will be achieved.

3.1.2 Sediment Load Analysis and Allocation

This section describes the results of the sediment load analysis. For the technical details of this analysis refer to Appendix F. Response reach channel instability likely results from a combination of excess water and coarse sediment production. However, until further evaluation of up slope flow and sediment impacts is complete, a more definitive answer is not possible. As stated above, the Jim Ford Creek WAG and TAG have agreed to complete a more in-depth analysis. Unfortunately, this evaluation cannot be completed before the final TMDL is due.

In the interim, a simple one-dimensional coarse sediment loading analysis estimates the bedload transport rate reductions needed to achieve the desired channel condition. The load capacity and reductions presented below are estimates and should not be considered absolute. This coarse sediment load analysis estimates the bedload transport rate reductions needed to reduce the rate of aggradation, stabilize the stream bed, and reduce the frequency of channel migration of response reaches. The sediment load reduction is based on the present and desired (i.e., load capacity) bedload transport rate of transport reaches relative to the particle size distribution of the bed-material.

Flow and sediment modeling indicate that to reduce the mobility of bed-material stored in transport reaches, and increase the d_{50} particle size from 118 to 128 mm, the daily average bedload transport rate of material less than 118 mm needs to be reduced about 52 tons per day at bankfull discharge (Table 21). Modeling the minimum and maximum measured d_{50} particle size of transport reaches provides a range of needed reductions and shows that for reaches that have finer bed-material, a greater reduction is needed.

Because there are no point sources of sediment to Jim Ford Creek, the coarse sediment load reductions are allocated to non-point sources. Due to the lack of a complete sediment budget, specific allocations to subwatersheds and land uses cannot be made at this time and a gross allocation is made. The results and recommendations from subsequent analyses will be used to revise the sediment load reduction and load allocation scheme (see as part of the Administrative Record the Jim Ford Creek Sediment Source Analysis Framework).

Table 21. Sediment TMDL Components for Non-point Sources

Existing Load (t/d)	Load Capacity and Allocation (t/d)	Load Reduction (t/d)
75	23	52 (70%)

(t/d) = tons per day

3.1.3 Margin of Safety and Critical Conditions

An implicit MOS is used to develop the coarse sediment TMDL. The implicit MOS is equated into the sediment targets, load capacity, and load analysis using a set of conservative assumptions. In addition, an adaptive management approach is used to further support the TMDL.

The sediment targets are established using conservative values derived from theoretical thresholds and regional reference conditions. The residual pool volume target is established using the theoretical threshold approach where the best pool conditions measured within lower Jim Ford Creek as part of the aquatic habitat inventory are used to establish the target. The bankfull width to depth target is established using regional reference conditions, and is established using a conservative target value (see Appendix E for details). The load capacity is established using an inferential link between measured channel stability, habitat conditions, and bedload transport rates. This linkage is supported by a qualitative conceptual model and a series of simplifying assumptions (see Appendix F for details).

The load analysis involves modeling stream flow and bedload transport. A "design" reach is used in this analysis over which channel geometry and substrate conditions are averaged. This reach is intended to represent the range of transport reach conditions for lower Jim Ford Creek. Critical to this analysis framework is the use of the measured average d_{50} particle size (i.e., 118 mm) as the existing condition. This value provides the most accurate representation of actual conditions.

The last piece of the MOS is the use of the Sediment Source Analysis Framework to support further analysis of the problem and to develop a set of numeric hillslope targets. These targets will be used to further develop the TMDL allocation scheme and are to be used as part of the TMDL implementation plan.

The critical conditions for beneficial use support and target attainment considered in the coarse sediment TMDL include: 1) channel geometry; 2) water temperature needs; 3) timing of migration; and 4) long-term salmonid spawning and rearing needs. All of the flow and sediment analyses, to include the channel stability analysis, have built in assumptions that attempt to account for critical conditions: for example, the use of bankfull discharge as the flow that maintains the stream channel over the long-term. Other specific assumptions and factors that account for critical conditions are described in detail in Appendices D, E, and F.

3.2 Temperature

The Jim Ford Creek TMDL was established to address thermal loading (heat) for the protection of chinook salmon and steelhead spawning and other cold water biota. The TMDL establishes percent reduction targets (instream temperature) for nonpoint sources in each subwatershed. These percent reduction targets are linked to "Percent Increase in Shade" targets for each subwatershed, thereby reducing the overall rate of increase in instream temperature throughout the watershed. For point source activities, no wasteload allocations were given to the point sources (City of Weippe and Timberline High School WWTPs) because they are not sources of thermal loading July 1 through August 15, identified as the warmest time period (critical time period) for the upper watershed.

3.2.1 Targets

The Jim Ford Creek watershed was evaluated for both cold water biota and salmonid spawning (IDAPA 16.01.02.120) due to two distinct hydrologic reaches. Upper Jim Ford Creek, flows primarily through the Weippe prairie, and is protected for cold water biota. Lower Jim Ford Creek, flows through a steep, narrow canyon and is protected for salmonid spawning from the waterfall at approximately stream mile 14 to the mouth. This TMDL addresses fisheries concerns resulting from impairments due to water temperature increases. The State of Idaho temperature criteria protects several species of fish in both Upper and Lower Jim Ford Creek as described in Section 2.1.6 of the subbasin assessment. The temperature targets for Jim Ford Creek are shown below in Table 22.

Table 22. Designated Beneficial Use and Applicable Criteria

Beneficial Use	Criteria	Where Standard Applies
Salmonid Spawning	Water temperature of thirteen (13°C/55°F) or less with a maximum daily average no greater than nine (9°C/48°F) IDAPA 16.01.02.250.02.d.(ii)	Lower Jim Ford Creek waterfall to mouth
Cold Water Biota	Water temperatures of twenty-two (22°C/72°F) or less with a maximum daily average no greater than nine (19°C/66°F) IDAPA 16.01.02.250.02.c.(ii)	Upper Jim Ford Creek waterfall to headwaters

3.2.2 Condition Assessment

3.2.2.1 Thermograph Location

Twenty-five continuously recording thermographs were strategically placed throughout the watershed. From June through September, 9 thermographs were installed in 1998 and 16 in 1999. Stream temperatures were evaluated for each subwatershed. See Appendix G for subwatershed and thermograph locations. Records were obtained of instream temperature every 1.6 hours (1998) and every 4 hours (1999) at each site. Sites included: main stem Jim Ford Creek; all major tributaries; and springs in two subwatersheds. (Spring near the headwaters of Wilson Creek (between August and October 1998), and spring below the waterfall on Jim Ford Creek (June through September 1999)).

Stream temperature in a watershed is driven by the interaction of many instream variables described in Section 2.2.3.2. Energy exchange may involve solar radiation, longwave radiation, evaporative heat transfer, convective heat transfer, conduction, and advection, interacting with channel characteristics.

3.2.2.2 Temperature Patterns

Stream temperatures in 1998 and 1999 often exceeded the Idaho temperature criteria during the low flow period of the year. Stream temperatures in Upper Jim Ford Creek were cooler in the headwater areas and warmer on the prairie. Stream temperature increased (approximately 5°C) from the headwaters of Wilson Creek through the Weippe Prairie to the waterfall. Stream temperature criteria were not exceeded in Wilson Creek (1998 and 1999) and Wilson Creek headwater spring (1998). Exceedances of the daily average temperature criteria were noted in Upper Jim Ford Creek. Stream temperatures in 1999 were cooler than 1998, and temperature patterns were vastly different. Peak stream temperatures in 1998 occurred in mid-July, while in 1999, peak temperatures occurred in late August.

Stream temperatures in Lower Jim Ford Creek were cooler immediately below the waterfall due to inflow of groundwater and shade from canyon walls. Temperatures gradually increased as water flowed through the canyon to the confluence with the Clearwater River, increasing 5 °C between the waterfall and Green Bridge, located 5 miles downstream. No significant gain in temperature was observed downstream of Green Bridge to the confluence with the Clearwater River, a distance of 7.5 miles (Appendix G). Salmonid spawning temperature criteria were exceeded at the mouth of Jim Ford Creek for both years, with cooler temperatures in 1999 than 1998. Generally, throughout the watershed, temperatures were exceeded in early July through mid-August (Appendix G, thermograph plots).

Frequency of recurring stream temperatures was evaluated for each subwatershed. Based on the 1998 and 1999 thermographs, the highest frequently occurring temperature during the warmest time period (July 1 through August 15) was 23°C and the coolest frequently occurring

temperature was 18°C. Temperature frequencies are summarized by subwatersheds in Appendix G.

Upper Jim Ford Watershed has sub-optimal amounts of riparian vegetation to provide stream shading, and areas of increased soil compaction, accelerated bank erosion, and channel downcutting. These impacts have increased the water surface area available for heating, resulting in stream temperature criteria exceedances (Figure 14).

The CWE assessment (IDL 1999) found insufficient canopy cover to maintain stream temperatures in Lower Jim Ford Creek canyon. In addition, the east-west orientation of the basalt canyon allows for continual solar loading throughout the day. During the summer, unshaded, low flowing reaches allow maximum long-wave radiation to be absorbed by the water (IDL 1999 and Appendix C).

The Jim Ford Creek TMDL utilizes stream shading adjustments in order to meet the temperature criteria.

3.2.2.3 Stream Shade

Forest practices, grazing, and agricultural activities within the riparian zone can have a significant effect on canopy closure. Canopy cover contributes to the rate of increase in instream temperature. Without riparian shade trees, most incoming solar radiation energy is available to heat the stream. Riparian vegetation effectively reduces excess solar radiation loading. In the Jim Ford Creek watershed, existing riparian shade conditions were evaluated through aerial photo interpretation (Washington Forest Practices Board, 1997) and verified through field validation (Appendix G). Average shade values are presented in Table 23.

Figure 14. Processes Contributing to Solar Loading

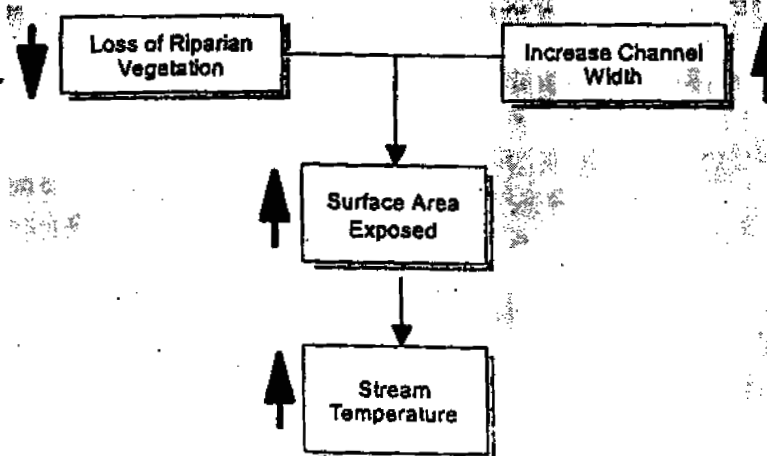


Table 23. Average Existing Shade Condition in the Jim Ford Creek Watershed

Riparian Vegetative Shade Conditions	
Stream Segment	Average Existing Shade Condition
Miles/Wilson Subwatershed and mainstem Jim Ford Creek to confluence with Heywood Creek (entire subwatershed)	19%
Kamiah Gulch	29%
Heywood Creek Subwatershed	30%
Grasshopper Creek Subwatershed	31%
Mainstem Jim Ford from confluence with Heywood Creek to confluence with Grasshopper Creek	14%
Mainstem Jim Ford from confluence with Grasshopper Creek to waterfall	48%
Mainstem Jim Ford from waterfall to confluence with Winter Creek	39%*
Mainstem Jim Ford from mouth of Winter Creek to mouth of Shake Meadow Creek	52%*
Mainstem Jim Ford from mouth of Shake Meadow Creek to confluence with Meadow Creek	58%*
Mainstem Jim Ford, mouth of Meadow Creek to confluence with Clearwater River	68%*
Winter Creek Subwatershed	33%

*Mean of 54% used in SSShade to represent Lower Jim Ford Canyon

3.2.3 Evaluation of the Critical Time Period (exceedance period)

The designated use for aquatic life for Jim Ford Creek (source to mouth) and Grasshopper Creek (source to mouth) is cold water biota. Since the presence of salmonids has been documented on mainstem Jim Ford Creek below the anadromous fish barrier at the canyon waterfall (streammile 14), the water quality criteria for salmonid spawning is applicable from the falls to the mouth. Thus, two distinct hydrologic reaches were evaluated to determine the "critical time period". The critical time period is the time of warmest instream temperatures during the interval when Idaho temperature criteria are exceeded. This time period was used for model calibration to climate and instream conditions.

The designated beneficial use of cold water biota requires that Upper Jim Ford Creek meet the daily average temperature criteria of 19°C. The 1998 thermographs in Upper Jim Ford Creek were collectively evaluated to establish the critical time period. Based on this evaluation, the critical time (when violations occurred) was July 1 through August 15 (Figure 15). During this time interval, no thermal assimilative capacity was available and daily average stream temperatures exceeded the cold water biota criteria. Wilson Creek, a tributary to Upper Jim Ford Creek, had no exceedances during this time. Many tributaries in Upper Jim Ford Creek met the Idaho cold water biota criteria during this time period in 1999 (Figure 16).

The beneficial use designation of salmonid spawning, requires that Lower Jim Ford Creek meet the daily average temperature criteria of 9°C during the time period of salmonid spawning and incubation identified by the State of Idaho (see Section 2.2.1.3). Temperatures in 1998 and 1999 for Lower Jim Ford Creek, exceeded 9°C beginning in early June and continuing through September (Figure 17). During this time period, no thermal assimilative capacity was available in Lower Jim Ford Creek. June 9 to August 15 (no data prior to June 9) was defined as the critical time period for needed reductions. Management for temperature reductions during this time interval should be effective extending into September. A noticeable decline in stream temperature is observed in 1999 as compared to 1998. However, the 1999 temperatures still fail to meet the Idaho salmonid spawning criteria of 9°C (Figure 18). Winter Creek, a tributary to Lower Jim Ford Creek, was modeled to meet the water quality criteria of 9°C, as it is accessible to salmonids from its mouth to a waterfall barrier at stream mile 0.75.

Annual shifts in stream temperature are climatologically related. Conditions at the time of this study are discussed below. The Pacific Northwest saw radical weather shifts during the summer of 1998, when western North America transitioned from the second strongest El Nino event of the 20th century, with a dry, warm winter to a moderate-strong La Nina event with a cold, wet winter.

May 1998 for the Clearwater Region was anomalously very wet, 3.8 - 7.0" (130% - 290% of normal), but had near normal temperatures. June 1998 was wet but only at the mid- to high elevations. Lower elevations (i.e. Lewiston) were fairly dry. Temperatures stayed 1-2 degrees below normal with late spring showers carrying over to the first week of July. Strong convective storms with abundant showers occurred the last few days of July. Precipitation totals for July varied from 1.2 - 3.9" (110% - 160% of normal). Intense thermal ridging in July brought scorching, hot conditions across the region, culminating with many high temperature records broken on July 26th. July 1998 was the hottest month in historical record and the (in-direct) proxy record going back a thousand years for much of the United States. This thermal ridging continued into August, and very little precipitation fell across the region. Temperatures exceeded 3°F above normal for both months.

In 1999, spring in the Clearwater Basin was very cold with near-normal (90% - 110%) snow-packs. May was dry and cold (3-4 degrees below normal). June had near-normal moisture and cold temperatures (3 degrees below normal). July was very dry with cold temperatures (2 - 3

degrees below normal). August had above normal (110-130% of normal) moisture and temperatures one degree above normal (Martin 1999).

3.2.4 Loading Capacity and TMDL Allocations

TMDLs may be expressed in terms of mass per unit time, toxicity, or other appropriate measures (40 CFR 130.2(i)(0)). Separate loading capacities have been developed for Upper and Lower Jim Ford Creek watershed as it is protected by two different temperature criteria. As an "other appropriate measure" for the TMDL, a percent reduction target in instream temperature has been set for each subwatershed to meet the prescribed loading capacities. This TMDL focuses on temperature reductions during the critical time period, the warmest interval when criteria are exceeded. Percent reduction targets are linked to "Percent Increase in Shade" targets for each subwatershed to meet the Idaho temperature criteria.

3.2.4.1 Loading Capacity

The loading capacity for Upper Jim Ford Creek is the Idaho water quality criterion of 19°C. The loading capacity for Lower Jim Ford Creek below the waterfall is 9°C. The achievement of the loading capacity in Lower Jim Ford Creek will rely on reductions from both the Upper and Lower Jim Ford Creek watershed portions. Improved conditions upstream (i.e. lower channel width/depth ratios, increased shade, and increased flow) will result in lower temperatures downstream.

3.2.4.2 TMDL Waste Load Allocation

The City of Weippe and Timberline High School WWTPs are the only point sources in the Jim Ford Watershed. The City of Weippe WWTP does not discharge during the critical time period in the upper watershed (July 1 through August 15), therefore they are not a source of heat during the critical time being addressed by the TMDL, and will not receive a wasteload allocation for temperature (heat). - -

Timberline High School WWTP discharges into Grasshopper Creek. Flow data has been reported in monthly discharge monitoring reports, but no temperature data is available. Records show that the high school discharges periodically up through the month of July at a rate of 0.0001 cfs to 0.005 cfs. No discharge in August has been reported. During the summer of 1999 stream temperature upstream and downstream of the high school discharge was measured using recording thermographs. Analysis of the data using a Student's T-test shows no significant difference in stream temperatures above and below their outfall ($p < 0.05$) (Appendix G). Since there is no data to indicate that this treatment plant is a source of heat to Grasshopper Creek, a wasteload allocation for temperature (heat) has not been established for the Timberline High School WWTP discharge.

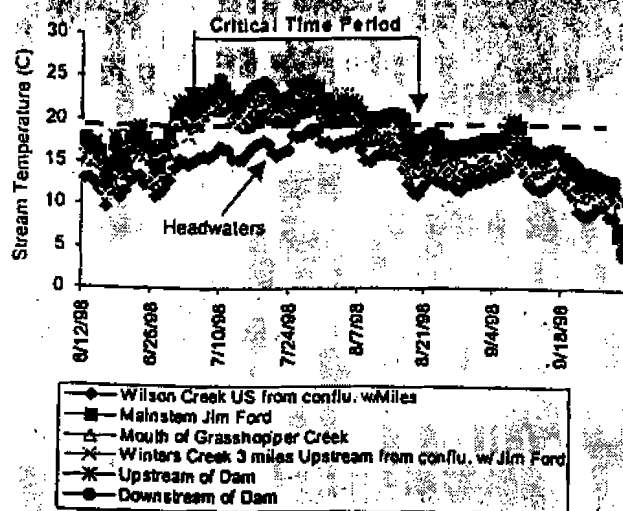


Figure 15- Thermographs in the Upper Jim Ford Creek Watershed during the Critical Time Period (1998)

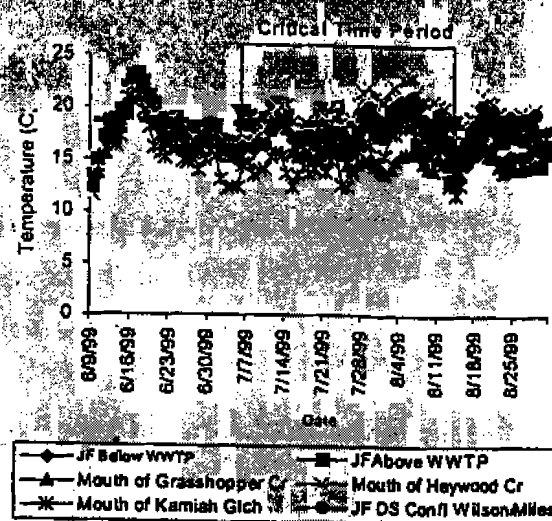


Figure 16 - Thermographs in the Upper Jim Ford Creek Watershed during the Critical Time Period (1999)

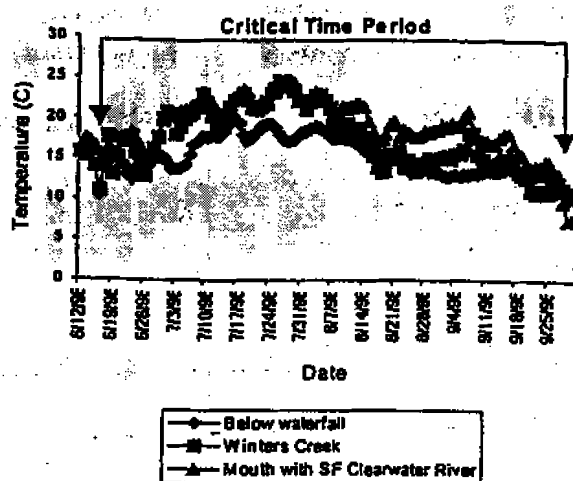


Figure 17- Thermographs in the Lower Jim Ford Creek Watershed during the Critical Time Period 1998

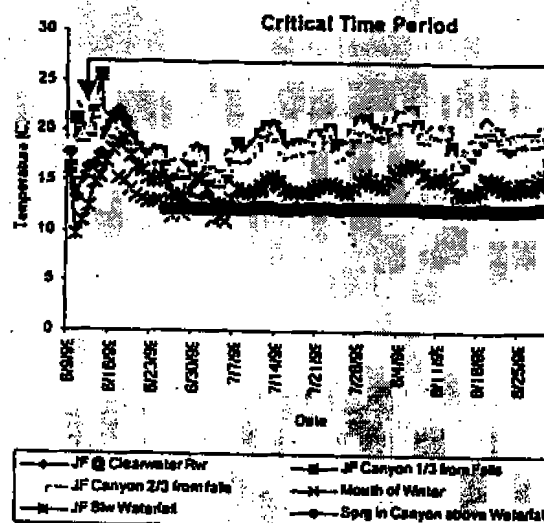


Figure 18 - Thermographs in the Lower Jim Ford Creek Watershed during the Critical Time Period

3.2.4.3 Percent Reduction Targets

Percent reduction targets for Upper Jim Ford Creek were established for each subwatershed to attain the mean daily Idaho temperature criteria of 19°C. Targets were established using frequency distribution charts of 1998 instream temperature, for each subwatershed (Appendix G), representing most frequently occurring instream temperatures during the critical time period (July 1 through August 15). The year 1998 was used to establish the percent reduction targets in order to provide a conservative estimate representing warmest conditions. This provides assurance that prescribed targets will be effective during worst case conditions. Table 24 identifies the most frequent instream temperature and the corresponding percent reduction needed to meet the Idaho temperature criteria. Methods for calculating percent reductions are identified in Appendix G.

Table 24. TMDL/Allocation and Percent Reduction Target

Watershed Name (length in mi.)	TMDL/Allocations		
	Frequent Instream Temperature (°C)	Loading Capacity (°C)	Percent Reduction in Stream Temperature (%)
Upper Jim Ford Creek			
Miles Creek/Wilson Creek	16	19	0
Kamiah Gulch	15	19	0
Heywood Creek	20	19	5
Grasshopper Creek	23	19	17
Mainstem Jim Ford from confluence with Heywood Creek to confluence with Grasshopper Creek	21	19	10
Mainstem Jim Ford from confluence with Grasshopper Creek to waterfall	22	19	14
Lower Jim Ford Creek below waterfall*	13	9	31
Winter Creek	15	9	40

* Groundwater inflow reduces temperature 5°C below the falls.

Percent reduction targets set for Lower Jim Ford Watershed and Winter Creek establish the decrease in instream temperature to attain the mean daily Idaho temperature criteria of 9°C. In developing reduction targets for these subwatersheds, a major factor taken into consideration was

the role of groundwater. A 1999 thermograph placed in the spring 1/4 mile above the mainstem Jim Ford Creek waterfall (streammile 14) showed that groundwater temperatures averaged about 12°C, and reduced instream temperature consistently by 5°C (Figures 19 and 20). Thus percent reduction targets for Lower Jim Ford Creek were established using a combination of instream temperature frequency distribution charts during the critical time period, and this groundwater effect (Appendix G). Table 24 identifies the most frequent instream temperature and the corresponding percent reduction needed to meet the Idaho water quality criteria.

3.2.4.4 Development of Corresponding Shade Targets

The percent temperature reduction target for each subwatershed may be translated into corresponding subwatershed shade targets. These provide baseline goals for the Jim Ford Creek Watershed Restoration Strategy (WRS, Appendix H). It would be desirable to increase these percentages voluntarily at the Jim Ford WAG's discretion, in areas where shade increases are minimal or unnecessary to meet criteria (ie. Wilson-Miles Subwatershed). Improving stream conditions and shade levels in all subwatersheds, headwater areas, and low-order tributaries will aid in lowering downstream temperatures. The WRS, as further developed by the Jim Ford Creek WAG, will promote the attainment of water quality criteria through watershed improvement projects, restoration activities and best management practices. The success of the WRS relies heavily on the cooperation of State and private landowners in the watershed.

The Stream Segment Temperature Model (SSTEMP) was used to develop the shade target for each subwatershed. Calibration of the model for each subwatershed relied on stream temperature data, estimated streamflow data and climatic information for the identified critical time periods. The Stream Segment Shade Model (SSHADE), a sub-component of SSTEMP, was used to estimate existing and desired riparian shade for specific channel widths. The Stream Segment Solar Model (SSSOLAR) was used to estimate solar radiation available to increase instream temperature at a given time of year. Parameters for SSSOLAR and SSSHADE included: streamflow; relative humidity; wind speed; cloud cover; vegetative characteristics (site potential characteristics); and air temperature. Air temperature data was available for three weather stations: Weippe, Dworshak, and Pierce. Location and elevation of the subwatershed determined choice of air temperature station for use in the model. Relative humidity wind speed and cloud cover dstimations were made using the NOAA Climatic Atlas (see Margin of Safety). Estimated relative humidity was corrected for changes in elevation within each subwatershed (Appendix G). Daily average streamflow, a critical factor in the model calibration exercise, was limited to sporadic, instantaneous readings obtained from IDEQ BURP field sheets. Additional streamflow data should be collected to more fully characterize this watershed.

Each watershed was calibrated using available thermographs. Appendix G shows thermograph locations. Results of calibration showed that the degree difference between the modeled stream temperature and the observed stream temperature was 1°C - 2°C (Appendix G). This suggests that the model can predict mean daily stream temperature within a reasonable range given the data deficiencies.

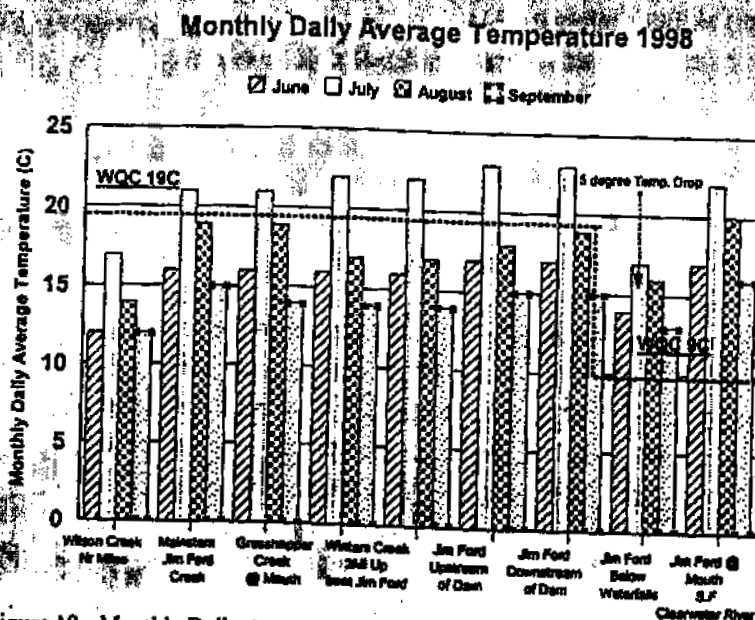


Figure 19 - Monthly Daily Average Temperature (1998) showing the effects of the springs on stream temperature

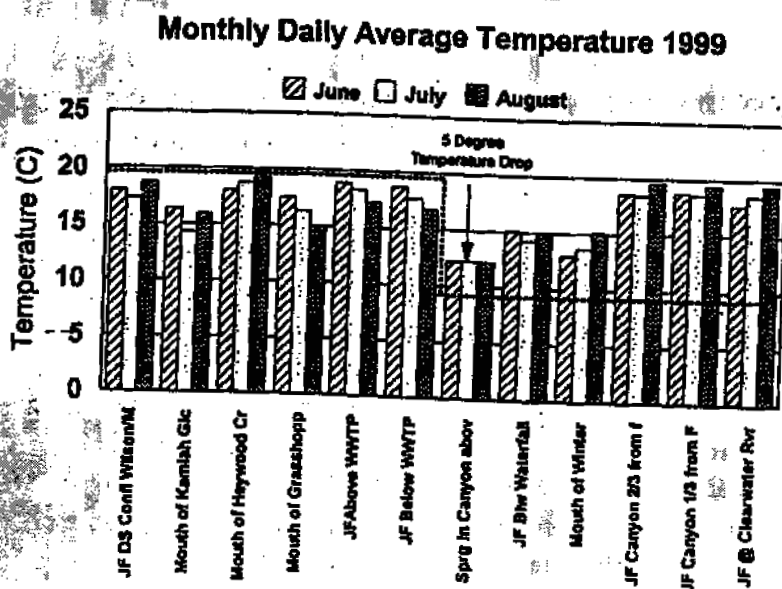


Figure 20 - Monthly Daily Average Temperature (1999) showing the effects of the springs on stream temperature

Climax vegetative species were identified by local land management agencies to develop shade targets for each subwatershed (Clapperton, 1999b and Hoffman, 1999b) (Table 25). Riparian vegetative characteristics, including range of height, were identified for three sub-regions (Figure 21). A solar angle of 60° (June through September), the height of mature, riparian vegetation required to shade the middle of the stream channel, stream orientation, topographic altitude, and time of year were used to calculate shade needed within each subwatershed for temperature improvement. Average vegetative height for each sub-region is shown in Table 25. Final shade targets, summarized in Table 26, represent increases required to meet the percent reduction targets and water quality criteria. Monitoring will be an integral part of the strategy as criteria attainment will occur overtime, and adjustments incorporated in a phased TMDL approach. As the stream recovers, other factors may work to decrease temperatures, including narrowing and deepening of the channel, colder water contributions from improved segments upstream, or increased flow from possible flow alterations.

Table 25. Potential Vegetative Heights Within Each Subwatershed

Sub-Regions	Subwatershed	Vegetative Climax Species	Potential Height (ft)
Upper (Upstream confluence of Wilson/Miles)	Wilson Creek, Miles Creek, Winter Creek, Grasshopper Creek	Conifer, Douglass Fir, Grand Fir, Cedar	123
Middle (Weippe to Falls)	Heywood Creek, Kamiah Gulch, Unnamed Creek 1, Unnamed Creek 2, Jim Ford Creek (between falls and junction of Miles and Wilson)	Alder, Willow, Ponderosa Pine, Camas, Lodgepole Pine, Orchid Grass, Sedges and Rushes, Cottonwood	50
Lower Canyon below falls to mouth	Shake Meadow, Meadow Creek, Lower Jim Ford	Conifer, Douglass Fir, Grand Fir, Cedar, Ponderosa Pine	116

Achievement of 9°C temperature criteria in lower Jim Ford Creek watershed should occur overtime as a result of improvements in both Upper and Lower Jim Ford Creek. It is recognized that while the model is restricted to developing shade targets, meeting the criteria will best be accomplished by also promoting channel restoration that leads to a narrower, deeper channel, colder water contributions from improved segments upstream, and/or increases in flow from changes in water yield patterns. Restoration of beneficial uses for steelhead and chinook in the lower watershed requires temperatures within preferred levels for steelhead (10-13 °C), and chinook (12-14 °C), and spring/summer chinook spawning (5.6-13.9 °C) (Bjornn and Reiser 1991). A stream protection zone for lower Jim Ford Creek and tributaries should be established

and enforced to ensure that anthropogenic activities do not further increase stream temperatures. Monitoring will assess effects of restoration activities on temperature and targets may be adjusted with improvement. The State of Idaho and the US EPA Region 10 are currently conducting temperature studies which could result in changes in the temperature criteria and trigger revision of the TMDL. Per the State of Idaho's TMDL guidance and concurrence of the US EPA and the Nez Perce Tribe, the ultimate measure of TMDL success is beneficial use support.

Figure 21. Dominant Vegetation Types in the Jim Ford Creek Watershed

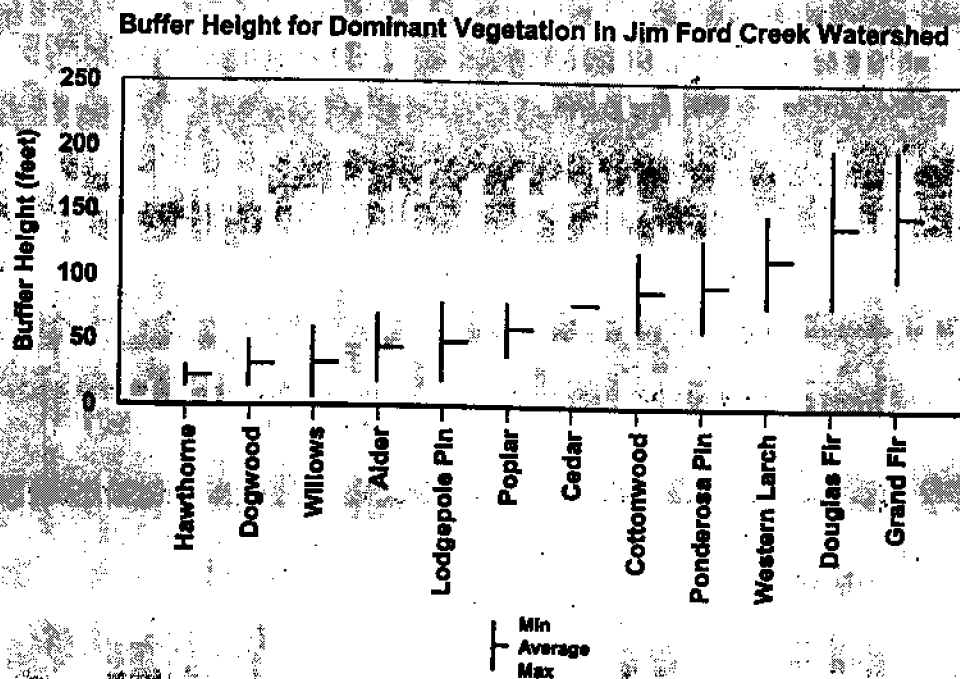


Table 26. TMDL/Allocation and Percent Increase in Shade Needed for Upper Jim Ford Creek

Watershed Name (length in mi.)	TMDL Allocations			
	Frequently Occurring Temperature During Critical Time Period (°C)	Loading Capacity (°C)	Percent Reduction in Stream Temperature (%)	Percent Increase in Shade to Meet TMDL Target (%)
Upper Jim Ford Creek				
Miles Creek/Wilson Creek ('99)	16	19	0	0
Kamiah Gulch	15	19	0	0
Heywood Creek	20	19	5	14
Grasshopper Creek	23	19	17	52
Mainstem Jim Ford from confluence with Heywood Creek to confluence with Grasshopper Creek	21	19	10	40
Mainstem Jim Ford from confluence with Grasshopper Creek to Jim Ford waterfall	22	19	14	50
Lower Jim Ford Creek				
Winter Creek	15	9	40	47
Lower Jim Ford Creek (below waterfall)	13	9	31	40

3.2.5 Margin of Safety

3.2.5.1 Adaptive Management

The Jim Ford Creek Watershed Restoration Strategy (Appendix H) developed with assistance from the WAG identifies restoration activities and best management practices which will ensure progress toward criteria attainment. This strategy provides the framework for the implementation plan which will include a high level of project detail. The Jim Ford Creek TMDL is intended to adapt to implementation, allowing for future changes to the loading

capacity and surrogate measures (allocations) in the event that data collection illustrates needed adjustments. The Jim Ford Creek WAG may initiate changes in implementation strategies based on progress toward meeting the beneficial uses and water quality criteria in consultation with the governmental agencies jointly developing the TMDL.

3.2.5.2 Assumptions

A margin of safety is factored into the temperature simulation methodology. Conservative estimates of streamflow, wind speed, relative humidity, and cloud cover were used in calibrating SSSOLAR and SSTEMP, and in developing the "Percent Increase in Shade" targets for each subwatershed. A list of assumptions and documented data sources used in calibrating and running the SSTEMP Model for each subwatershed within Jim Ford Creek are shown in Table 27.

Table 27. SSTEMP Parameters

Parameter	Assumptions/Data Source
Relative humidity	Range from 20% - 40% depending upon Elevation / <i>NOAA Climatic Atlas</i> , CRITFC
Wind speed	8 mph / <i>NOAA Climatic Atlas</i>
Streamflow	Use instantaneous measures, IDEQ BURP field sheets (Appendix B)
Percent possible sun (cloud cover)	80% / <i>NOAA Climatic Atlas</i>

3.2.5.3 Seasonal Variation

Section 303(d)(1) requires TMDLs to be "established at a level necessary to implement the applicable water quality criteria with seasonal variations." Both stream temperature and streamflow vary seasonally from year to year. Water temperatures are coolest in the winter and early spring months. Stream temperatures in this watershed exceed the Idaho water quality criteria primarily in mid summer (July through August). Warmest stream temperatures correspond to areas with prolonged solar radiation exposure, warm air temperature and low flow conditions. These conditions occur during mid summer and lead to the warmest seasonal instream temperatures. The analysis presented in this TMDL represents mid-summer conditions when the controlling factors for stream temperature are most critical.

3.3 Nutrients and Dissolved Oxygen

This section describes the Jim Ford Creek nutrient and dissolved oxygen TMDLs components. The targets, load capacity, load analysis, load allocation, and margin of safety and critical conditions are described below. For simplicity, the technical details of this analysis are described in Appendix J.

3.3.1 Nutrient and Dissolved Oxygen Targets

Two State surface water quality standards set narrative nutrient limits. The first standard (IDAPA 16.01.02.200.05) limits floating, suspended, or submerged matter that impair beneficial uses. The second standard (IDAPA 16.01.02.200.06) limits nuisance aquatic growth that impairs beneficial uses (see Appendix A for Water Quality Standards). The Jim Ford Creek TAG's numeric interpretation of the narrative standard, which applies between April and October, is as follows: 1) nitrogen not to exceed 0.23 mg/L TIN¹; and 2) phosphorus not to exceed 0.075 mg/L for total phosphorus (TP), expressed as a monthly average concentration with seasonal application.

These targets are based on work by Bauer and Burton (1993) and U.S. EPA (1986) and incorporate an explicit 25% MOS. Bauer and Burton (1993) recommend nitrate concentration less than 0.30 mg/L, and the *U.S. EPA Quality Criteria for Water* (U.S. EPA 1986) recommend total phosphorus levels not to exceed 0.10 mg/L in the water column of a stream that does not drain into a lake or reservoir to control aquatic growth. Total inorganic nitrogen (TIN) provides a more conservative measure than nitrate at the same target level. TIN was selected for this analysis because only the inorganic forms of nitrogen (ammonia, nitrite, nitrate) were measured in 1998.

Recent nutrient samples that included the organic portion of nitrogen suggest that there may be a large fraction of organic nitrogen. For example, sample results show that Wilson Creek on August 18, 1999 contained 0.021 mg/L TIN, comparable to TIN levels at other upper reach sites. Total kjeldahl nitrogen (TKN) was measured at 0.35 mg/L. In this sample total nitrogen would be increased 94% by adding the organic portion. Because we do not yet know which fractions are used by aquatic growth in this system, future nutrient sampling and monitoring should be for total nitrogen (TN), including ammonia, nitrate/nitrite, and TN measures. Once it is understood what forms of nitrogen are used by aquatic plants in this system, revisions to the TMDL should consider the use of TN as a target instead of TIN.

Data show that algae is present in Jim Ford Creek throughout the year. Nutrients enter the system and are stored in sediments and biota. Presently, there is not enough information to determine the time frame when excessive aquatic growth impairs beneficial uses or the time

¹TIN is used in order to incorporate 1998 data. A total nitrogen target should be considered in revised TMDL to account for large organic fraction.

frame for nutrient loading that causes that growth. Dissolved oxygen data, collected diurnally, indicate that impairment is occurring during the summertime, however, impairment may not be restricted to this season. Until better information is available, the nutrient targets apply April through October. For the nutrient load analysis, the nutrient load capacity is calculated using the period of April through July for the following reasons: 1) no nutrient data are available for August through October; 2) this is the critical algae growing period which coincides with low dissolved oxygen levels; and 3) nutrient loads are the highest during these months providing an implicit MOS. This period is referred to as the averaging period. The averaging period is defined as the period of time used to estimate the existing nutrient load. If the allocations in this TMDL do not result in meeting the nutrient and dissolved oxygen targets, revisions to the allocations and averaging period should be considered.

This analysis provides recommendations on how the nutrient targets will be evaluated in the future. It is difficult to define this given the available data, and some of the specific recommendations may change as new data become available. Given this, the nutrient target concentrations should be evaluated on a monthly basis between April and October. This scheme provides a mechanism for the point sources to measure their nutrient discharge relative to the instream targets defined in this TMDL.

A monitoring plan, which outlines the sampling scheme, will need to be developed as part of the TMDL implementation plan.

The numeric dissolved oxygen criteria applicable to cold water biota and salmonid spawning beneficial uses of Jim Ford Creek are found at IDPA 16.01.02.250.02.c and d. (see Appendix A for Water Quality Standards). These criteria are established as targets for the dissolved oxygen TMDL.

The cause-and-effect relationship between nutrients, water temperature, plant growth and decomposition, and low dissolved oxygen levels is well established. As a result, it is expected that the substantial reductions in water temperature and nutrient concentrations of Jim Ford Creek, which will result from meeting the TMDL targets, will result in increased dissolved oxygen levels. Since there is inadequate information at present to establish a quantitative relationship between the nutrient targets and dissolved oxygen, it is necessary to make a key assumption that the prescribed nutrient reductions will result in meeting the dissolved oxygen targets.

3.3.2 Estimate of Load Capacity

This section describes the nutrient TMDL load capacity estimates. The load capacity is established in pounds per month over the averaging period (ie, April through July) for the subwatersheds of Jim Ford Creek. The load capacity is calculated by multiplying the instream nutrient target and stream discharge. For this analysis, the 50th percentile average daily discharge for each month of the water year are estimated (see Hydrology Section 2.1.3 for details), and are

multiplied by the nutrient targets (ie, 0.075 mg/L TP and 0.225 mg/L TIN). The results from these calculations are listed in Table 28 and 29. For the load calculation tables refer to Appendix J.

Table 28. TMDL Loading Analysis Results for Total Phosphorous (units in pounds per month)

Subwatershed	Number of samples #	Load Capacity	Existing Load	Existing Waste Load	Non-point source Load Allocation	Waste Load Allocation	Non-point source Load Reduction	Non-point source % Reduction
Jim Ford Creek near mouth	43	1801	2353	none	1801	none	552	23
Winter Creek	14	161	113	none	161	none	0	0
downstream Weippe	40	593	737	30	563	30*	174	24
Grasshopper Creek	17	233	244	1.3	144	1.3 ^	12	5
upstream Weippe	18	534	793	none	331	none	259	33
Heywood Creek	13	161	238	none	100	none	77	32
Miles/Wilson Creeks	14	198	267	none	123	none	69	26

= used to calculate the 84th percentile nitrogen concentration over averaging period

* = Weippe WWTP

^ = THS WWTP (no reduction)

The nutrient loading from the WWTPs is accounted for in the load capacity. However, load capacities were not calculated for individual WWTPs because the targets are based upon instream concentrations outside of the permitted mixing zone.

3.3.3 Estimate of Existing Nutrient Load

This section describes the existing nutrient load estimates. The existing nutrient load is estimated in pounds per month for April through July for the subwatersheds of Jim Ford Creek. The 50th percentile stream discharge values are multiplied by the measured concentrations of TP and TIN (NO₃/NO₂ + NH₃). Due to the limited amount of nutrient data, the 84th percentile concentration for each month of the averaging period is calculated and multiplied by the respective 50th percentile stream discharge to estimate the existing nutrient load. The results from these calculations are listed in Table 28 and 29. For technical details of this analysis refer to Appendix J.

The existing nutrient load from the WWTP is calculated using the same method used for non-point sources. The main difference is that the measured WWTP discharge values are used to estimate the 50th percentile flow. The WWTP instream nutrient load is part of the measured instream load at the downstream monitoring site below the effluent mixing zone. The only subwatersheds that have contributions from point sources are Grasshopper Creek and mainstem Jim Ford Creek downstream of Weippe (Tables 28 and 29).

Table 29. TMDL Loading Analysis Results for Total Inorganic Nitrogen (units in pounds per month)

Subwatershed	Number of samples #	Load Capacity	Existing Load	Existing Waste Load	Non-point source Load Reduction	Non-point source % Reduction
Jim Ford Creek near mouth	43	4289	1016	none	0	0
Winter Creek	14	483	51	none	0	0
downstream Weippe	40	1780	647	164	0	0
Grasshopper Creek	17	700	69	0.3	0	0
upstream Weippe	18	1601	261	none	0	0
Heywood Creek	13	484	65	none	0	0
Miles/Wilson Creeks	14	595	95	none	0	0

= used to calculate the 84th percentile nitrogen concentration over averaging period

• = Weippe WWTP (no reduction)

^ = THS WWTP (no reduction)

3.3.4 Load Allocation

This section describes the nutrient TMDL load allocation scheme. Nutrient loads are allocated to subwatersheds to help identify those areas contributing to the cumulative nutrient load. In effect, for the subwatersheds with no point sources, the load capacity is the load allocation. Typically, sources are allocated part of the load capacity. Because the majority of the TP load to Jim Ford Creek is from non-point sources, there are no point source load reductions required by this TMDL. Table 28 and 29 summarize the phosphorus and nitrogen load allocation and percentage reduction for the averaging period, respectively.

Generally, the nutrient load analysis indicates that the TP load of Jim Ford Creek needs to be reduced between 25 and 30%. The TP load of lower Jim Ford Creek needs to be reduced about

23% to achieve water quality standards. Of the seven subwatersheds that contribute to lower Jim Ford Creek, the greatest contributors of phosphorous appear to be Heywood and Miles/Wilson Creeks upstream of Weippe (Table 28). In addition, phosphorous reductions are needed at the three other sites along the mainstem (Table 28).

The nutrient load analysis indicates that the majority of the TP load is from non-point sources. As a result, the non-point sources are allocated all of the needed nutrient load reductions. For the two point sources contributing nutrients to Jim Ford Creek, no load reductions are required because, according to the available data, they do not contribute a substantial amount of TP. For example, nutrient data indicate that at the downstream Weippe monitoring site below the Weippe WWTP, 96% of the measured TP load is from non-point sources.

To meet TMDL requirements the point sources need a waste load allocation. For this TMDL, the point source waste load allocation is set at the existing measured nutrient load. The existing load is estimated using all available nutrient data, however, these data are very limited. For example, the existing nutrient load is estimated using 23 samples taken over one water year. This is a rough estimate of the actual nutrient load and will be revised, if needed, using nutrient data gathered subsequent to the final TMDL. The Jim Ford WAG is implementing a 18 month nutrient study to quantify the Weippe WWTP nutrient load relative to the instream load. Results from this monitoring will be used to revise the TMDL and develop the WWTP's discharge permit.

Reasonable assurance supports this approach to the nutrient load allocations. The following components document the reasonable assurance that the nonpoint sources will be able to meet the load allocations: 1) letters showing land owner commitment to implement BMPs; 2) identification of funding sources available to implement BMPs; and 3) a monitoring plan which measures BMP implementation and effectiveness. The Jim Ford Creek WAG in conjunction with land management agencies (ISCC and IDL) have developed a package which supports the use of reasonable assurance in this TMDL. Land management agencies and private landowners, have submitted letters of support/commitment to implement best management practices to reduce nutrient loading to Jim Ford Creek. The SCC, the Nez Perce Tribe, and the Jim Ford WAG have applied for 319 grant dollars to implement restoration projects. In addition to proposed 319 funding, dollars have been appropriated through the Federal Environmental Quality Incentive Program (EQIP) to aid BMP implementation in the Jim Ford Creek Watershed. Also, State funding is presently being pursued to also ensure that nonpoint implementation occurs. Finally, a monitoring plan will be developed with the intent of measuring the amount and implementation of BMP and improvements in water quality.

Given the above information, the Weippe WWTP discharge permit will be written at their existing nutrient load. Presently, the WWTP is discharge about 30 pounds of TP during the averaging period. Data gathered as part of future monitoring will be used to complete a rigorous loading analysis to determine what percentage of the total nutrient load is attributed to the WWTP. Shallow groundwater seepage from the Weippe WWTP was documented to contain

water year, it is difficult to account for the critical conditions created by extremely low water yield which, in effect, represents the most critical condition. To offset this problem, a more conservative approach to the load calculations is taken to estimate the existing nutrient load (see Appendix J for details).

3.4 Pathogens

3.4.1 Targets and Load Capacities

Idaho water quality rules set instantaneous (acute) and monthly (chronic) numeric limits for fecal coliform bacteria levels (IDAPA 16.01.01.250.01 a&b). Different standards apply during the primary contact recreation (PCR) season (between May 1 and September 30) and the secondary contact recreation (SCR) season (between October 1 and April 31). Recreational designated uses for Jim Ford Creek and Grasshopper Creek are PCR and SCR. Table 32 indicates the applicable fecal coliform criteria.

Table 32. Applicable Fecal Coliform Criteria

Designated Use	Fecal Coliform Criteria
Primary Contact Recreation (applicable May 1-Sept. 30)	≤ 500 cfu/100 mL - at all times 200 cfu/100 mL - $\leq 10\%$ of samples over 30 days ≤ 50 cfu/100 mL - geometric mean of at least 5 samples over 30 days
Secondary Contact Recreation (applicable Oct. 1-April 30)	≤ 800 cfu/100 mL - at all times 400 cfu/100 mL - $\leq 10\%$ of samples over 30 days ≤ 200 cfu/100 mL - geometric mean of at least 5 samples over 30 days

(cfu = colony forming unit)

For this TMDL, both the instantaneous and geometric mean criteria were used to determine daily and seasonal load capacities, respectively. The geometric mean criteria was chosen instead of the percent exceedance criteria due to the limited data. In addition to conservative assumptions, an explicit margin of safety of 20% was included to determine the load capacity, as further detailed in Section 3.4.5.

The State of Idaho has proposed rules that, if approved by the Board of Health and Welfare and the Legislature, would replace the recreation contact criteria based on fecal coliform bacteria to one based on *E. coli* bacteria. This change is proposed because *E. coli* is more reflective than fecal coliform of direct contamination from feces of warm-blood animals and thus considered to be a better indicator of potential human health risks involved in the water's recreational use. The U.S. EPA recommends *E. coli* be used as water quality criteria for pathogens (U.S. EPA 1986). Since this proposed rule is not in effect, this TMDL is based on the existing fecal coliform rule. However, a loading analysis based on *E. coli* was conducted for comparative purposes and results are presented in Appendix I.

Appendix I also provides a condition assessment that summarizes the fecal coliform and flow data that will be used in the load analyses, trends associated with that data, and critical conditions.

3.4.2 Instream Load Analyses

This section provides the approach for and results of load, load capacity, and load reduction calculations based on instream fecal coliform and flow data described in the previous section. This load analysis considered seasonality given it was based on PCR season. It evaluated both acute and chronic criteria. A margin of safety is addressed through choice of conservative conditions for the loading analysis as well as an explicit margin of safety used to the load capacity.

3.4.2.1 Important Assumptions

Existing loads are based on instream measurements. This can underestimate the load to the stream since assimilation or processing of pollutant loads usually occurs between the point of entry to the water and the point its quality is monitored. This is particularly true of bacteria, which are living organisms subject to die-off once they leave their source. On the other hand, ignoring assimilation can overestimate instream concentrations given actual source load estimates. A constant die-off rate, and thus constant measured fraction, is a simplifying assumption made here that allows proceeding with a quasi-mass balance loading analysis.

Because a daily flow record could not be generated, it is assumed that the flow estimates based on the limited sampling data are representative of overall variable flow conditions. This generalization either underestimate (if flows are much higher than represented by sampling data) or overestimate (if flows are much lower than represented by sampling data) of loads. For the daily load analysis where the same flow was multiplied by data concentrations for the existing load estimate and multiplied by target concentrations for the load capacity, the estimated load reduction is not dependent on the flow. For the chronic load analysis, however, flow estimates affected the overall load reduction estimated during the PCR season.

Comprehensive bacteria sampling data were only available for 1998. Consequently, it was assumed that 1998 conditions are representative of the general bacteria levels and locations conditions in the watershed over time. It is assumed that the dates sampled are representative of a range of flow conditions and concentrations, such that a geometric mean based on the existing data is similar to the geometric mean if more were data collected in the same period. At the sample location with the greatest sampling frequency during the PCR, only 17 of the 153 days in the PCR season were sampled, or 11%. The PCR geometric mean criteria is based on a minimum of 5 samples taken over a 30 day period. Some of the 1998 reconnaissance samples were collected less frequently than this minimum.

Some bacteria can multiply in the water column under extremely favorable conditions (called aftergrowth), such as in systems rich with organic sediments, especially estuarine mud. This analysis assumes that instream bacteria levels are attributed to sources and not to aftergrowth, a conservative assumption.

A final assumption was that instantaneous concentrations measurements based on a single sample per day accurately represent the concentration, and thus the load, for a whole day.

3.4.2.2 Summary of Approach

For each station, the maximum and minimum fecal coliform concentrations were deleted from the data set used for load analyses to remove "outliers" and estimate representative conditions. The 95% percentile concentration, or the concentration below which 95% of the 1998 measured concentrations fell, was then calculated for the remaining data set and this concentration was multiplied by the 95% percentile flows estimate. Daily load capacities were determined by multiplying the 95% percentile flows by acute criteria. Using these 95% levels provides a level of conservatism. Estimated load reductions were then calculated by comparison between the existing load estimate and the load capacity. Since the flows used to determine both were the same, the reductions were calculated by comparing 95% concentrations to the acute criteria of 500 cfu/100 mL. An explicit margin of safety was then included by using 400 cfu/100 mL as a target instead of the PCR instantaneous criteria of 500 cfu/100 mL. This is a 20% reduction in the loading capacity. For comparative purposes, a calculation of the load reductions needed to meet the 500 cfu/100 mL were compared to the load reductions needed to meet the more conservative 400 cfu/100 mL.

The PCR geometric mean fecal coliform criterion of 50 cfu/100 mL was used for the chronic loading analysis. For each 1998 sampling location, the geometric mean for each month during the PCR season was calculated. The geometric mean was calculated using the data available in a month regardless of the number of samples taken in that month; usually less than 5 samples were collected in a month. For example, in August and September, only one sample was taken upstream of Weippe. The geometric mean for those months was the concentration of that one sample.

To estimate flows representative of the sampling months at each station, the average flow was calculated based on flow estimates for the date sampled. Using average flows instead of geometric mean adds another conservative step to the analysis. Again, average flows were calculated for the month regardless of the number of flow estimates available for that month. At two sites, no staff readings were taken in September, consequently September average flows were estimated based on August flows and the simulated hydrograph described in Appendix I.

An explicit additional margin of safety was included by targeting an instream geometric mean fecal coliform concentration of 40 cfu/100 mL. This 20% margin of safety, or a 20% reduction in load capacity. For comparative purposes, a calculation of the load reductions needed to meet the 50 cfu/100 mL were compared to the load reductions needed to meet the more conservative 40 cfu/100 mL.

Given the uncertainty of the flow estimates, an additional analysis was performed based on comparing the geometric mean for all data during the PCR at each site to the 40 cfu/100 mL criterion. Finally, to test the choice of analysis based on the PCR instead of SCR, a loading

analysis based on the SCR geometric criteria was conducted using the same methodology as the PCR loading analysis.

All fecal coliform loads are expressed in counts (# of colony forming units or cfu) per day and per month using the formulas below. Flow is expressed as Q or cubic feet per second (cfs); fecal coliform levels are expressed as FC.

$$1) FC \times Q \times 1000 \text{ mL/liter} \times 28.3 \text{ liter/ft}^3 \times 60 \text{ sec/min} \times 60 \text{ min/hr} \times 24 \text{ hr/day} \\ \text{or } FC \times Q \times 2.44 \times 10^7 \text{ cfu/day} = \text{cfu/day}$$

$$2) FC \times Q \times 1000 \text{ mL/liter} \times 28.3 \text{ liter/ft}^3 \times 60 \text{ sec/min} \times 60 \text{ min/hr} \times 24 \text{ hr/day} \times 30 \text{ day/month} \\ \text{or } FC \times Q \times 7.33 \times 10^8 \text{ cfu/month} = \text{cfu/month}$$

Because the values are so large, all the values for cfu/day and cfu/month were divided by 10^9 to express loads in billion of cfu (bcfu) per day or month. Therefore, the conversion factors for converting the product of flow in cfs and concentration in cfu/100 mL are .0244 and .733, respectively.

3.4.2.3 Results of Instream Loading Analysis

Table 33 provides the estimated daily loads, load capacities, and load reductions for the PCR season. No estimates are provided for Miles, Heywood, and Winter Creeks due to the lack of flow data; however, load reductions can still be calculated using the ratio between the criterion and 95% concentration. The number of sampling data at each site in the PCR is also provided as an indication of the limitations of this analysis. Results indicate that load reductions are necessary at upstream Weippe, Miles, and Winter Creeks but not at the other locations. Adding the 20% MOS increased the estimates of needed reductions from 68% to 74% for Miles Creek and 34% to 47% for Winter Creek.

Table 34 provides the estimated seasonal load, load capacity, and estimated load reductions using the chronic methodology described previously. Results indicate that load reductions are necessary at all sampling locations except for the mouth. The greatest reductions is needed at upstream of Weippe and the least reductions is needed at the mouth of Grasshopper Creek. Because of the substantial reductions already needed to meet 50 cfu/100mL, meeting the 40 cfu/100 mL requires only marginal increases in percent load reduction.

Table 33. Results of Daily Load Analysis

Site	95% FC, cfu/100 mL	n	Existing Load, (bcfu/day)	Load Capacity, (bcfu/day)	% Load Reduction w/o MOS	% Load Reduction w/20% MOS
Mouth of Jim Ford	69.7	16	144	827.1	None	None
Downstream of Weippe	267.5	14	267.6	400.2	None	None
Upstream of Weippe	444	17	336	302.6	None	10%
Grasshopper Creek	151.5	11	66.5	175.7	None	None
Miles/Wilson Creeks	1560	11	NA	NA	68%	74%
Heywood Creek	348	11	NA	NA	None	None
Winter Creek	756	11	NA	NA	34%	47%

(FC = fecal coliform, n = number of samples, bcfu = billion colony forming units, MOS = margin of safety)

Table 34. Results of Chronic Loading Analysis

Site	PCR Load, bcfu	PCR Load Capacity, (bcfu)	% Reduction without Margin of Safety	Percent Reduction with 20% Margin of Safety
Mouth of Jim Ford	6,300	8,570	None	None
Downstream of Weippe	4,390	2,310	34%	47%
Upstream of Weippe	8,020	1,470	77%	82%
Grasshopper Creek	1,270	850	17%	33%
Miles/Wilson Creeks	5,990	1,790	63%	70%
Heywood Creek	3,880	1,460	53%	62%
Winter Creek	3,920	1,480	53%	62%

(bcfu - billion colony forming units)

To examine the influence of flow estimates on the chronic analysis, the load reduction was calculated based on comparing the geometric mean during the PCR at each site to the 40 cfu/100mL criterion. No reductions are needed at the mouth under both scenarios. Estimated reductions are within 10% of each other under these two scenarios for the Grasshopper, Heywood, and Winter Creek stations. For the stations downstream and upstream of Weippe, approximately 20% less reduction is needed without flow considered, probably given the higher flow estimates at these stations compared to the tributaries. For Miles Creek, the estimated reduction is greater without flow considered than with flow considered, probably because of the very high concentrations that occurred during low flow months (July, Aug, Sept) in the PCR.

Table 35. Estimated Fecal Coliform Reductions

Site	Reduction with flow considered	Reduction without flow considered
Mouth of Jim Ford	None	None
Downstream of Weippe	47%	18%
Upstream of Weippe	82%	63%
Grasshopper Creek	33%	30%
Miles/Wilson Creeks	70%	90%
Heywood Creek	62%	73%
Winter Creek	62%	73%

The load capacity of Grasshopper Creek is much lower than the other tributaries, which would indicate that flows at Grasshopper are less than those of other tributaries. However, based on drainage area, it would be expected that flow of Grasshopper Creek would be higher, as predicted in the Horn (1987) analysis (Appendix I). The major difference was in the average flow estimates for May 1998 (9 cfs based on the 1998 data and 58 cfs based on the Horn analysis.) This lower flow estimate for May lead to the lower load capacity in the PCR season. However, the analysis without flow data just comparing the criterion to the geometric mean during the PCR season provides close results in terms of load reductions to the analysis based on the 1998 flow estimates (30% vs. 33%, respectively (Table 35)). Since it is the load reductions that set the stage for implementation, the results for Grasshopper Creek are considered acceptable for the TMDL. Certainly the aberration observed for Grasshopper Creek lend yet more emphasis on the importance of having adequate flow measurements and estimates for TMDL implementation monitoring.

As a test of the choice of the PCR instead of the SCR season for analysis, an identical chronic loading analysis indicated no need for load reductions during the SCR season since the existing loads did not exceed the load capacity.

Table 36 compares the necessary load reductions to meet the daily criterion versus those to meet the chronic criterion. Idaho code requires both to be met; consequently, the load reductions for the TMDL are the most conservative. Reductions needed to address chronic fecal coliform levels are greater than those needed to address acute or daily levels, except for Miles Creek where the estimated needed reduction is 74% under daily load and 70% under chronic load. These percentages are close enough to accept the chronic load analysis as the basis for the TMDL.

Table 36. Estimated Fecal Coliform Reductions Based on Acute and Chronic Criteria

Site	Daily Reduction with 20% Margin of Safety	Chronic Reduction with 20% Margin of Safety
Mouth of Jim Ford	None	None
Downstream of Weippe	None	47%
Upstream of Weippe	10%	82%
Grasshopper Creek	None	33%
Miles/Wilson Creeks	74%	70%
Heywood Creek	None	62%
Winter Creek	47%	62%

As a check, the above specified chronic reductions were applied to the existing data set. Results indicated both water quality criteria would be met using the same load analysis procedures previously described.

3.4.3 Load Analysis for Point Sources

3.4.3.1 Weippe WWTP and Underdrain

Underdrain

In 1991 a drainpipe was installed under the lagoon #1 to provide drainage for spring water. Although the underdrain was designed to convey groundwater, it also conveys wastewater. As a part of the TMDL, the underdrain was evaluated as a source of pollutant load to Grasshopper Creek using the limited sampling conducted in 1999. Based on the available sampling data

presented in Table 37, the underdrain was determined to be a contributor of fecal coliform to Grasshopper Creek.

Table 37: Results of Sampling at Lagoon 1 Underdrain

Sampling Date	Fecal Coliform (cfu/100mL)			<i>E. coli</i> (organisms/100mL)		
	US	DC	DS	US	DC	DS
5/13/99	5	30	1	5	40	<1
6/24/99	29	60	26	16	25	20
7/22/99	1,800	1,200	2,600	170	610	170

US = upstream of underdrain on Grasshopper Creek, DC = underdrain discharge,

DS = downstream of underdrain on Grasshopper Creek

Because the City of Weippe will be eliminating the underdrain discharge from Grasshopper Creek, a WLA of 0lbs/day is set for the underdrain.

Weippe WWTP

The Weippe WWTP is currently permitted to discharge 50 cfu/100mL fecal coliform during the PCR. Since the Weippe WWTP discharge is restricted based on 50:1 dilution, the plant usually stops discharge either in May or June. The Weippe WWTP has discharged during the following months in the past five years:

1999 to date: discharged January through April

1998 - discharged February through June

1997 - discharged January through May

1996 - discharged January through June

1995 - discharged February through June

In 1998, data from the WWTP showed that the permitted level was rarely reached. Of the 27 samples collected in 1998, 14 had fecal coliform results of 0 cfu/100mL. The average discharge on those sampling dates was 0.5 cfs. During the PCR season, 5 discharge samples were collected had a geometric mean of 28 cfu/100mL; discharge on those sample dates averaged 0.2 cfs.

Data from multiple years was available for WWTP discharge since the City of Weippe measures flow daily and fecal coliform once a month during the discharge season. For the months in the PCR season when the WWTP discharged between 1993 and 1998, the average monthly discharge flow was multiplied by the monthly fecal coliform level provided on the City's monthly Daily Monitoring Report (DMR) and the conversion factor to determine monthly load. The monthly loads were then summed for the PCR season. The same method was used to determine what the load would have been in these years had the fecal coliform level been at the permitted level of 50 cfu/100mL. The flow is an average of daily discharge flows; however, the bacteria level is that

measured in a sample collected once a month by the City. An assumption was made that this level is representative of the average. Another assumption is that if discharge occurred during the month, then it occurred during the whole month, which is not always the case. This adds conservatism to the load estimates. Finally, loads were also calculated based on 5 samples of the discharge taken in 1998 during the PCR season using average flow and average fecal coliform concentrations. Table 38 presents results of all these analyses.

Table 38. Fecal Coliform in Weippe WWTP Discharge During PCR Season

Year	Number of Months	Load Based DMR Data (bcfu/PCR season)	Load based on Permitted Levels (bcfu/PCR Season)
1993	3	22.7	99.4
1994	2	99.5	45.6
1995	2	3.8	9.7
1996	2	4.7	20.1
1997	1	7.4	18.3
1998 - DMR	2	3.3	13.8
Average	2	23.5	34.5
1998 TMDL		15.5	19.1

bcfu = billion colony forming units; DMR = Daily Monitoring Report, PCR - primary contact recreation

For consistency purposes, the existing WWTP load and load based on permitted levels used in this TMDL analysis were those generated from the 1998 data set during the PCR (15.5 and 19 cfu/100 mL, respectively). Those values are less than 1% of the chronic load capacity during the PCR season generated at downstream Weippe (refer to table 34).

3.4.3.2 Timberline High School WWTP

The Timberline High School WWTP is currently permitted to discharge 50 cfu/100mL fecal coliform during the PCR. Unlike the Weippe WWTP, this facility permit is not based on a set dilution flow ratio in Grasshopper Creek. Based on the DMR reports, the discharge season is variable, as indicated in table 39.

Table 39. Timberline High School Discharge During the PCR Season

Year	Months in PCR Discharged
1999 to Date	June
1998	May and July
1997	May, July, and Sept.
1996	No discharge in PCR
1995	June, July, and Sept.
1994	May
1993	May and June

Fecal coliform is not sampled for monthly DMRs; consequently, the only fecal coliform data that could be used in the TMDL was 1998 data. Flow is measured once a month during discharge months. Discharge measurements (48 measurements) taken between 1990 and 1998 averaged .003 cfs; this average did not vary significantly just using flow data from the PCR season (.002 cfs). For the load analysis, two approaches were evaluated. In the first analysis, the average flow was multiplied by the average concentration during PCR and load was generated for two months discharge at these levels. In the second analysis, this average flow was multiplied by the permitted discharge limit of 50 cfu/100 mL. Table 40 presents these results. Due to the very low discharge, the load is very low and represents approximately less than .001% of the load capacity at the mouth of Grasshopper Creek--the contribution to the load from the Timberline High School discharge is basically insignificant.

Table 40. Estimated Fecal Coliform Load During PCR from Timberline High School WWTP

Average Flow, cfs	Load Based 1998, (bcfu/PCR season)	Load Based on Permitted Levels, (bcfu/PCR season)
.003	.011	0.22

3.4.4 TMDL Allocations

Load Allocation

This section discusses how the Jim Ford Creek WAG decided that load capacity be divided among the subwatersheds and various sources of bacteria in the watershed. Table 34 presents the loading analysis that is the basis of the fecal coliform bacteria TMDL and identifies load capacities to be allocated among point and nonpoint sources. Allocations need to be set for the areas of the watershed where water quality criteria are exceeded. Consequently, no load allocations will be set at the mouth. The amount that can be allocated for each tributary is the load capacity identified in Table 34, which also lists the percentage reductions need for these tributaries. Table 34 also lists the load capacities and estimated needed reductions for locations on the mainstem of Jim Ford Creek upstream and downstream of Weippe. However, these reductions estimates do not take into consideration reductions at locations upstream. To evaluate whether any further reductions would be necessary for sources draining to Jim Ford Creek if estimated reductions were obtained on the tributaries, the following steps were followed:

- 1) The reduction in bacteria levels between the upstream and downstream of Weippe locations on mainstem Jim Ford Creek was calculated by determining the ratio between the load at downstream of Weippe and the total load of upstream of Weippe, Grasshopper Creek, and Weippe WWTP combined. This ratio was 47%.
- 2) Based on step 1 results, a conservative assumption was made that 50% of the load at Miles/Wilson and Heywood Creeks are reflected in the load at upstream of Weippe. This assumption is conservative since more assimilation will occur than that demonstrated between upstream and downstream Weippe locations since the Miles and Heywood creeks are a greater distance from upstream of Weippe than the distance between upstream and downstream of Weippe. 50% of the combined loads of these tributaries represented 60% of the load calculated at upstream of Weippe.
- 3) The needed reductions were applied to the loads at the tributaries and this amount was multiplied by 50% to represent the portions of the reduced loads that would contribute to loads at the upstream of Weippe location.
- 4) The amount calculated in step 3 was added to 40% of the total load at upstream of Weippe, which is the portion estimated to come from sources draining into the upper portion of Jim Ford Creek but not the headwater tributaries.
- 5) The result of step four (4,710 bcfu) is the load estimated at upstream of Weippe with reductions of the tributaries considered. A percent difference between 4,710 bcfu and the load capacity of 1,470 bcfu at upstream of Weippe of 69% was calculated. This represented the reduction needed from sources in the upper watershed that drain directly into Jim Ford Creek and not into its tributaries.

To answer the question as to whether additional reductions are needed between upstream and downstream of Weippe, the load capacities for Grasshopper Creek and upstream of Weippe were added to the load capacity for the Weippe WWTP discharge assuming permitted levels of discharge for two months. The total of 2,340 bcfu/season is 1% higher than the load capacity at downstream of Weippe of 2,310 bcfu/season. With assimilation considered, it can be reasonably predicted that load capacity at downstream of Weippe will not be exceeded with estimated load reductions accomplished in the upper portions of the watershed. Table 41 summarizes the results of this analysis and identifies the load capacities that can be allocated at critical target measuring points in the watershed. Because of the lack of nonpoint source sector specific information, the Jim Ford Creek WAG elected to derive a gross allocation for bacteria by subwatershed. Further analysis of the proportionate contribution among the various nonpoint sources will be evaluated during the implementation phase of the TMDL.

Table 41. Load Capacities to be Allocated at Critical Target Measuring Points

Site	PCR LOAD (bcfu/season)	PCR Load capacity (bcfu/season)	Load Reduction (bcfu/season)	% Reduction
Upper Jim Ford	4,710	1,470	3,240	69%
Grasshopper Creek	1,270	850	420	33%
Miles/Wilson Creeks	5,990	1,790	4,110	70%
Heywood Creek	3,880	1,460	2,420	62%
Winter Creek	3,920	1,480	2,440	62%

bcfu = billion colony forming units

Wasteload Allocation

For the Weippe WWTP and Timberline High School, the allocations are set at their existing permitted limits of 50 cfu/100 mL during the PCR. Because bacteria allocations in Jim Ford Creek are apportioned to both point and non-point sources, the TMDL must incorporate reasonable assurance that the nonpoint sources reductions will be implemented to meet the prescribed load allocations. For the Jim Ford Creek TMDL, bacteria load reductions from nonpoint sources will be achieved through a combination of future efforts being proposed by State of Idaho, Nez Perce Tribe and Jim Ford Creek Watershed Advisory Group as detail in Section 2.4.3.

Table 42 represents the final location allocations selected by the WAG. Further analysis of the proportionate contribution among the various nonpoint sources will be evaluated during the implementation phase of the TMDL.

Table 42. Final Load Allocations

Site	PCR LOAD (bcfu/season)	PCR Load Capacity (bcfu/season)		Load Reduction (bcfu/season)	Percent Reduction
Upper Jim Ford	4710	1,470	LA - 1450	3,240	69%
			Weippe WWTP WLA - 19 ¹		
Grasshopper	1,270	850	LA - 850	420	33%
			Timberline High School WLA - 0.22 ¹		
Miles/Wilson Creek	5,990	1,790		4,110	70%
Heywood Creek	3,880	1,460		2,420	62%
Winter Creek	3,920	1,480		2,440	62%

bcfu - billion colony forming units; LA = Load Allocation; WLA = Waste Load Allocation

3.4.5 Seasonal Variations and Margin of Safety

Section 303(d)(1) requires TMDLs to be "established at a level necessary to implement the applicable water quality standards with seasonal variations." Thus, the analysis must be conservatively based to address seasonal peaks, if any, that might occur in pollutant concentrations. This TMDL addresses seasonality by basing the load, load capacity, and load reduction estimates on the PCR season. This is a conservative approach since this is when the most stringent criteria apply and when the highest levels of fecal coliform concentrations occurred. This conservative approach is believed to result in protective allocations which account for seasonal peaks in bacteria concentrations, to the extent they are known given the data available.

Uncertainties inherent in developing the bacteria TMDL include: 1) lack of specific data on contribution of various nonpoint sources of bacteria; 2) lack of understanding and data on bacterial population dynamics; and 3) lack of comprehensive flow and concentration data.

Using the PCR as the basis of the TMDL provides a margin of safety since the water quality

¹The Waste Load Allocation (WLA) for both WWTPs is based on discharge at the permitted level of 50 cfu/100mL during the PCR.

criteria during this time period are lower than the criteria for the SCR season. A MOS was built into the daily load analysis in using 95% flow and 95% concentration data. A MOS was built into the chronic load analysis by using average flows instead of geometric-mean flows. An additional 20% explicit MOS included both daily and chronic load analyses by using targets that were 20% lower than applicable water quality criteria. The Jim Ford Creek WAG sees this 20% as a maximum MOS and that with more comprehensive data, the MOS will be reduced in a revised TMDL. The further load reductions this requires are small in comparison to the large reductions required without this extra MOS.

4.0 PUBLIC PARTICIPATION

4.1 Jim Ford Creek Watershed Advisory Group (WAG)

IDAPA 16.01.02.052 provides requirements for public participation in water quality decisions. Basin Advisory Groups (BAGs) and Watershed Advisory Groups recommend pollution control activities and advise appropriate agencies on priority impaired waterbodies and management of impaired watersheds. The Jim Ford Creek WAG was appointed by the Administrator of IDEQ in 1996 to fulfill the public participation requirements of Idaho Code 39-3601 et seq. Members selected for the WAG were recommended by the Clearwater BAG from nominations obtained from the local community to represent specific stakeholder groups within the watershed. In fall 1998, when IDEQ entered into a Memorandum of Agreement with the NPT and U.S. EPA, the NPT selected additional tribal representatives for the WAG, whom were then appointed to the WAG.

Since the WAG's initial public meeting in December 1996, they have met periodically and provided input and advice to the three implementing agencies throughout the development of the TMDL. Activities included reviewing the TMDL regulatory framework; conducting watershed tours and public meetings; and participating in the CWE Assessment project. The WAG has provided review of and input on a myriad and multitude of TMDL related reports and activities, including monitoring activities, watershed conditions, pollutant sources and control efforts, TMDL targets, and watershed history. The WAG also directed how TMDL allocations be divided among the various point and nonpoint sources.

The WAG has assisted greatly in the development of the Jim Ford Creek TMDL and their input is reflected in many portions of this document. The group has provided the community's perspective on appropriate watershed management actions through cooperative discussions of issues, recommendations, information, and advice. The WAG offers the following summary comments/concerns regarding the Jim Ford Creek TMDL.

WAG Comments on Temperature TMDL:

"The Jim Ford Creek Watershed Advisory Group (WAG) is supportive of the temperature TMDL methodology as described, and acknowledges the time and effort put into its preparation. However, the shade targets are predictions derived from a model, and the WAG would like to reiterate that shade alone will not reduce stream temperature in the watershed to meet State criteria, particularly in the lower canyon.

The WAG does not believe the 9°C criteria in the lower canyon is attainable no matter what practices are implemented in the watershed to try to achieve it. In fact, we doubt the temperature of this stream was ever that cold. The WAG questions how stream water temperature can be reduced to 9°C when groundwater from springs entering the stream is already 12°C.

The WAG recognizes that stream temperature in the watershed can and should be reduced, and would measure success as an improving trend rather than attainment of the criteria. All efforts made to achieve this goal should be economically feasible, returning effective results for the resources expended.

Because of the range of historical variability that most likely occurs in the watershed, we believe we are aiming at a moving target. The WAG recognizes that an adaptive management strategy that implements BMPs, then monitors and adjusts them as needed over time, is the most appropriate way to reduce temperature and improve overall water quality in Jim Ford Creek."

WAG Comments on Sediment TMDL:

"The WAG would like to reiterate its understanding that the sediment load analyses is preliminary and a more detailed sediment source analysis will be completed next year with the assistance of Potlatch and Idaho Department of Lands personnel, as reflected in sections 2.2.3.1 and 3.1 of the TMDL."

WAG Comments on Bacteria TMDL:

"The WAG considers the 20% margin of safety to be a maximum and that with more comprehensive data, the margin of safety will be reduced in a revised TMDL. Although the allocations were set on a subwatershed basis, the WAG would like further delineation of the proportionate pollutant load contributions among the various nonpoint sources as part of TMDL implementation."

4.2 Public Comments

The Jim Ford Creek draft TMDL was available for public review and comment from Monday, November 22, 1999 through Tuesday, December 21, 1999. Notification to the general public of the opportunity to comment on the draft TMDL was made in the *Orofino Clearwater Tribune*, (November 25, 1999), the *Clearwater Progress* (November 24, 1999), and the *Lewiston Tribune* (November 22, 1999). Copies of the TMDL were sent to each of the Jim Ford Creek WAG members, members of the Clearwater BAG, and members of the Jim Ford Creek TAG. Copies of the document were made available for review at the IDEQ Lewiston Regional Office, NPT Water Resources Division Lapwai Office, U.S. EPA Boise Office, Weippe City Library, Clearwater County Soil Conservation District Orofino Office, IDL Kamiah Office and Weippe City Hall. A public comment meeting was offered upon request. Appendix J provides a summary of the comments received during the public comment period and responses to those comments that identify changes made in the draft TMDL as a result of public comment.

5.0 REFERENCES

- Allen, S., J. Putera and Jazdzewski. 1986. Pacific Northwest Rivers Study, 1986 Final Report, Idaho. Idaho Department of Fish and Game. Boise, ID.
- American Public Health Association et al. 1975. Standard Methods for Examination of Water and Wastewater. 14th edition.
- Bauer, Stephen B. and T.A. Burton. 1993. Monitoring protocols to evaluate water quality effects of grazing management on western rangeland streams. USEPA Report No. 9101R-93-017. Seattle, WA.
- Bauer, Stephen B. 1989. Idaho Nonpoint Source Management Plan. Idaho Division of Environmental Quality Water Quality Bureau. Boise, ID.
- Bjornn, T.C., and D.W. Reiser. 1991. Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitat. Chapter 4: Habitat Requirements of Salmonids in Streams. American Fisheries Society Special Publication, vol 19.
- Bond, J.G. 1963. Geology of the Clearwater Embayment: Idaho Bureau of Mines and Geology Pamphlet No. 128. State of Idaho Department of Geology. Boise, ID.
- Bonner, Bud. 1999. Oral personal communication between Bud Bonner of the Jim Ford Creek Watershed Advisory Group and Carol Fox of IDEQ-LRO on 3/24/99 regarding historical conditions and land uses of the Jim Ford Creek watershed.
- Bonner, Bud and N. Steadman. 1999. Memo date March 14, 1999 from Bud Bonner and Norm Steadman of the Jim Ford Creek Watershed Advisory Group to Carol Fox of IDEQ-LRO regarding historical land uses in the Jim Ford Creek watershed.
- Clapperton, Jim. 1999a. Information regarding landslide in 10/5/99 letter to Jim Ford Creek TAG from Jim Clapperton of IDL Kamiah Office. Kamiah, ID.
- Clapperton, Jim 1999b. Personal oral communication between Jim Clapperton of IDL Kamiah Office and Curry Jones of U.S. EPA Seattle Office regarding climax vegetative species.
- Clearwater Basin Bull Trout Technical Advisory Team. 1998. Lower Clearwater River Bull Trout Problem Assessment, p 47.

- [CSWCD] Clearwater Soil and Water Conservation District. 1993. Agricultural Pollution Abatement Plan: Lolo/Ford's Creek Watershed, Clearwater and Idaho County, Idaho, Final Planning Report. Prepared in cooperation with the Clearwater Soil and Water Conservation District, Idaho Soil Conservation Commission, USDA National Resources Conservation Service, Idaho Division of Environmental Quality. p 106.
- Clearwater National Forest. 1977. Clearwater Subbasin Ecosystem Analysis. Prepared by the Clearwater National Forest. Orofino, ID.
- Cochnauer, Tim. 1999. Personal communication with Tim Cochnauer of IDFG Lewiston office and Ann Storrar of NPT Water Resources Division Lapwai Office.
- Dekan, George. 1998. Oral communication between George Dekan of IDEQ-LRO and Johanna Luce of IDEQ-LRO regarding drinking water supplies in Jim Ford Creek watershed.
- Edwards, T.K. and G.D. Glysson. 1998. Field methods for measurement of fluvial sediment. Chapter C2 in: Techniques of water-resources investigations of the U.S. Geological Survey, Book 3. U. S. Geological Survey, Washington, D.C.
- [FERC] Federal Energy Regulatory Commission. 1985. Environmental Assessment. Ford Power, FERC NO. 7986-000-Idaho. November 8, 1985.
- [FERC] Federal Energy Regulatory Commission. 1986. License to operate Ford Power Project No. 7986. 34FERC62,177. Issued January 17, 1986.
- Harrelson, C.C., C.L. Rawlins, and J.P. Potyondy. 1994. Stream channel reference sites: an illustrated guide to field technique. General Technical Support, RM-245, U.S. Department of Agriculture, Forest Service.
- Harvey, G. 1990. Problem assessment for water quality limited segment: Jim Ford Creek. Unpublished Report. IDEQ State Office. Boise, ID. 5 p.
- Hirsch, R.M. 1982. A comparison of four streamflow record extension techniques. Water Resources Research, Vol. 18, No. 4. p. 1081-1088.
- Hoffman, M. D. 1992. Lolo/Ford's Creek State Agricultural Water Quality Project: Monitoring and Inventory Assessment for 1991. Unpublished Report. Idaho Soil Conservation Commission, Orofino, Idaho. p 16.
- Hoffman, M. D. 1997. Personal communication with Mike Hoffman ISCC Orofino Office.
- Hoffman, M.D. 1999b. Personal oral communication between Mike Hoffman of ISCC Orofino Office and Curry Jones of U.S. EPA Seattle Office regarding climax vegetative species.

- Horn, D.R. 1987. Annual flow statistics and drought characteristics for gaged and ungaged streams in Idaho. Idaho Water Resources Institute. University of Idaho, Moscow, ID.
- [IDEQ] Idaho Division of Environmental Quality. 1980. Water Quality Summary Report No. 11: Jim Ford Creek, Clearwater County, ID.
- [IDEQ] Idaho Division of Environmental Quality. 1987. Water Quality Status Report: Jim Ford Creek. Clearwater County, Idaho. IDEQ Lewiston Regional Office. Lewiston, ID.
- [IDEQ] Idaho Division of Environmental Quality. 1988. Idaho Water Quality Status Report and Nonpoint Source Assessment. IDEQ Lewiston Regional Office. Lewiston, ID. p 170.
- [IDEQ] Idaho Division of Environmental Quality. 1992. Draft Water Quality Status Report: Lolo, Jim Ford, and Big Creek: Clearwater and Idaho Counties, Idaho. Unpublished Report, Lewiston Regional Office, Lewiston, ID.
- [IDEQ] Idaho Division of Environmental Quality. 1995, 1997, and 1998. Beneficial Use Reconnaissance Project assessments for Jim Ford Creek. Unpublished.
- [IDEQ] Idaho Division of Environmental Quality. 1996. 1996 Water Body Assessment Guidance: A Stream to Standards Process.
- [IDEQ] Idaho Division of Environmental Quality. 1998. Jim Ford Creek water quality monitoring study from January 1998 through September of 1998. unpublished.
- [IDEQ] Idaho Division of Environmental Quality. 1999. Sediment Targets Used or Proposed for TMDLs, draft guidance document prepared by Mike Rowe, Don Essig, and Jim Fitzgerald, January 1999. IDEQ State Office, Boise, ID.
- [IDFG] Idaho Department of Fish and Game. 1992. Anadromous Fish Management Plan: 1992-1996. Idaho Department of Fish and Game. Boise, ID.
- [IDFG] Idaho Department of Fish and Game. 1995. Bull Trout Distribution in Idaho. State of Idaho Department of Fish and Game. Boise, ID.
- [IDHW] Idaho Department of Health and Welfare. 1996. Idaho Water Quality Standards and Wastewater Treatment Requirements. IDHW Boise Office. Boise, ID.
- [IDL] Idaho Department of Lands. 1995. Forest Practices Cumulative Watershed Effects Process of Idaho.
- [IDL] Idaho Department of Lands. 1999. Jim Ford Creek Cumulative Watershed Effects Assessment, August 1999. p 20.

[ISCC] Idaho Soil Conservation Commission, Idaho Department of Health and Welfare and Idaho Department of Lands. 1993. Idaho Agricultural Pollution Abatement Plan. Boise, ID.

[ISCC] Idaho Soil Conservation Commission. 1997. Fecal coliform data for Jim Ford Creek. Unpublished data. Orofino, ID.

Krenkel, P.A., and Novotny, V., 1980. Water Quality Management. Academic Press, Inc., NY. p 671.

King, Dale. 1998a. Personal oral communication between Johanna Luce of IDEQ-LRO and Dale King of the Clearwater County Health District regarding drinking water systems in the Jim Ford Creek watershed.

King, Dale. 1998b. Personal oral communication between Mike Hoffman of the CSWCD and Dale King of the Clearwater County Health District regarding septic tank conditions in the watershed.

Kjelstrom, L.C. 1998. Methods for estimating selected flow-duration and flood-frequency characteristics at ungaged sites in central Idaho. US Geological Survey Water Resources Investigations Report 94-4120.

Kucera, P.A., J.H. Johnson and M.A. Bear. 1983. A Biological and Physical Inventory of the Streams within the Nez Perce Reservation. Nez Perce Fisheries Department. Lapwai, Idaho. BPA Agreement #DE-AI79-82BP33825.

Kucera, P. A. 1984. A Biological and Physical Inventory of the Streams within the Nez Perce Reservation. Report 82-1, Portland, OR.

Kucera, P.A. 1999. Personal oral communication between P. Kucera of the NPT Fisheries Division Lapwai Office and Ann Storrar of the Nez Perce Tribe Water Resources Division Lapwai Office.

Lipscomb, S.W. 1998. Hydrologic classification and estimation of basin and hydrologic characteristics of subbasins in central Idaho. US Geological Survey Professional Paper 1604.

Luce, Johanna. 1998. Oral communication provided by Johanna Luce of IDEQ-Boise Regional Office to Carol Fox of IDEQ-LRO regarding conditions observed on 1998 field visit of Jim Ford Creek watershed.

- Madej, M.A. 1999. What can thalweg profiles tell us?, a case study from Redwood Creek, California. Watershed Management Council Networker, Summer, Vol. 8 (4), pp. 1, and 14-18.
- Martin, Kyle. 1999. Memo dated 9/29/99 from Kyle Martin of the Columbia Inter-Tribal Fish Commission to Ann Storrar on the Nez Perce Tribe Water Resources Division regarding climatological trends.
- Montgomery, D. R. and J. M. Buffington. 1993. Channel classification, prediction of channel response, and assessment of channel condition. Report TFW-SH10-93-002.
- Moulton, Gary, ed. 1997. The Journals of the Lewis and Clark Expedition. Volume 9: The Journals of John Ordway and Charles Floyd. University of Nebraska press.
- [NMFS] National Marine Fisheries Service, Cottonwood Creek BLM, Clearwater National Forest, Nez Perce National Forest. 1998. "Matrix of Pathways and Indicators of Watershed Condition for Chinook, Steelhead and Bull Trout," Local Adaptation for Clearwater Basin and Lower Salmon. Revised 3/9/98. Cottonwood Creek BLM. Cottonwood, ID.
- National Weather Service. 1998. Climate Summary.
- Newcombe C.P. and J.O.T. Jensen. 1996. Channel Suspended Sediment and Fisheries: A Synthesis for Quantitative Assessment of Risk and Impact, North American Journal of Fisheries Management 16. p 693-727.
- [NRCS] National Resources Conservation Service. 1998. United States Department of Agriculture. Snotel Summary Data.
- [NPT] Nez Perce Tribe. 1997 and 1998. Unpublished Beneficial Use Reconnaissance Project assessments for Jim Ford Creek. NPT Water Resources Division. Lapwai, ID.
- [NPT] Nez Perce Tribe. 1999. Nez Perce Tribe Forest Management Plan. Nez Perce Tribal Forestry Division. Lapwai, ID.
- Owen, Amy. 1998. Personal oral communication provided by Amy Owen of the NPT Water Resources Division Office in Lapwai to Carol Fox of IDEQ-LRP regarding algae observations.
- Pinkham, Josiah. 1999. Personal oral communication of 12/29/99 between Josiah Pinkham of NPT Cultural Resources Lapwai Office and Rick Eichstaedt of NPT Water Resources Division Lapwai Office.

- Ralston, D.R., Gross, M., Cannon, M., Corbett, T., Eckwright, T., Gaillot, G., Allen, M. 1978. Reconnaissance Study of Ground Water Conditions At Weippe, Idaho. Class Project for Hydrology 501. University of Idaho, Department of Geology, Moscow, ID.
- Roseberg, Ralph. 1999. Personal oral communication between Ralph Roseberg of the USFWS Dworshak Office and Ann Storrar of the NPT Water Resources Division Lapwai Office regarding fisheries in Jim Ford Creek.
- Shawley, Stephen D. 1984. Nez Perce Trails. University of Idaho Anthropological Research Manuscript Series, No. 44. Moscow, ID.
- Simpson, J.C. and R.I. Wallace. 1982. Fishes of Idaho. The University of Idaho Press, Moscow, ID.
- Steadman, Norm. 1999. Personal oral communication from Norm Steadman of the Jim Ford Creek WAG provided at the 4/17/99 WAG meeting regarding fisheries in Jim Ford Creek.
- Stewart, Daniel. 1999. Personal oral communication between Daniel Stewart of IDEQ-LRO and Carol Fox of IDEQ-LRO regarding fisheries in Jim Ford Creek watershed.
- TerraGraphics. 1997. Hutchins Lumber Storm Water Pollution Prevention Plan. TerraGraphics Environmental Engineering, Moscow, Idaho. p 163.
- Thomann, R.V. and J.A. Mueller. 1987. Principles of Surface Water Quality Modelling and Control. Harper and Row, NY.
- [USFWS] United States Department of the Interior, Fish and Wildlife Service. 1978. Stream Evaluation Map: State of Idaho. United States Fish and Wildlife Service, Boise, ID.
- [USEPA] United States Environmental Protection Agency. 1986. Quality Criteria for Water 1986. EPA 440/5-86-001. USEPA, Office of Water, Regulations and Standards, Washington, DC.
- [USEPA] United States Environmental Protection Agency. 1991. Guidance for Water Quality-based Decisions: The TMDL Process. Report #440/4-91-00 p 58. Office of Water, Washington, DC.
- [USEPA] United States Environmental Protection Agency, 1999. Protocol for Developing Nutrient TMDLs. EPA 841-B-99-007. Office of Water (4503F), United States Environmental Protection Agency, Washington D.C.

- [USEPA] United States Environmental Protection Agency, 1999. Protocol for Developing Sediment TMDLs, EPA 841-B-99-004. Office of Water (4503F), United States Environmental Protection Agency, Washington D.C.
- [USFS] United States Forest Service. 1998. South Fork Clearwater River Landscape Assessment. Volume 1 - Narrative. USDA Forest Service Nez Perce National Forest. Idaho County, ID.
- [USGS] United States Geological Service. 1963. Weippe North Quadrangle. Idaho-Clearwater County. 7.5 Minute Series Topographic Map.
- Washington Forest Practices Board. 1997. Board Manual: Standard Methodology for Conducting Watershed Analysis under Chapter 222-22 WAC, Riparian Function Assessment Module, Part 2: Canopy Closure/Stream Temperature. Washington Forest Practices Board. Olympia. WA.
- Wetzel, R. G. 1983. Limnology. CBS College Publishing, New York, NY. p 767.

APPENDIX A IDAHO SURFACE WATER QUALITY STANDARDS

The following water quality criteria are applicable to the beneficial uses within the Jim Ford Creek watershed for the pollutants of concern listed on the 1994, 1996, and 1998 § 303(d) lists:

IDAPA 16.01.02.200.02

Toxic Substances. Surface waters of the State shall be free of toxic substances in concentrations that impair beneficial uses. These materials do not include suspended sediment produced as a result of nonpoint source activities.

IDAPA 16.01.02.200.03

Deleterious Materials. Surface waters of the State shall be free from deleterious materials in concentrations that may impair designated beneficial use.

IDAPA 16.01.02.200.05

Floating, Suspended, or Submerged Matter. Surface waters of the State shall be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses. This matter does not include suspended sediment produced as a result of nonpoint source activities.

IDAPA 16.01.02.200.06

Excess Nutrients. Surface waters of the State shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses.

IDAPA 16.01.02.200.07

Oxygen-Demanding Materials. Surface waters of the State shall be free from oxygen demanding materials in concentrations that would result in an anaerobic water condition.

IDAPA 16.01.02.200.08

Sediment. Sediment shall not exceed quantities specified in Section 250, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses. Determinations of impairment shall be based on water quality monitoring and surveillance and the information utilized as described in Subsection 350.02.b. Subsection 350.02.b generally describes the BMP feedback loop for nonpoint source activities.

IDAPA 16.01.01.250.01.a

Primary Contact Recreation: between May 1 and September 30 of each calendar year, waters designated for primary contact recreation are not to contain fecal coliform bacteria significant to the public health in concentrations exceeding:

- i. 500 colony forming units per 100 mL at any time; and
- ii. 200/100 colony forming units/100 mL in more than ten percent of the total samples taken over a thirty day period; and
- iii. A geometric mean of 50 colony forming units/100 mL based on a minimum of five samples taken over a thirty day period.

IDAPA 16.01.01.250.01.b

Secondary Contact Recreation: waters designated for secondary contact recreation are not to contain fecal coliform bacteria significant to the public health in concentrations exceeding:

- i. 800/100 colony forming units/100 mL at any time; and
- ii. 400/100 colony forming units/100 mL in more than ten percent of the total samples taken over a thirty day period; and
- iii. A geometric mean of 200 colony forming units/100 mL based on a minimum of five samples taken over a thirty day period.

IDAPA 16.01.01.250.01.c

Primary and Secondary Contact Recreation: All toxic substance criteria set forth in 40 CFR 131.36(b)(1), Column D2, revised as of December 22, 1992, effective February 5, 1993 (57 FR 60848, December 22, 1992). 40 CFR 131.36(b)(1) is hereby incorporated by reference in the manner provided in subsection 250.07; provided, however, that standard for arsenic shall be 6.2 ug/L for Column D2 (which constitutes a recalculation to reflect an appropriate bioconcentration factor for fresh water).

IDAPA 16.01.01.250.02.c

Cold Water Biota: waters designated for cold water biota are to exhibit the following characteristics:

- i. Dissolved oxygen concentrations exceeding 6 mg/L at all times.
- ii. Water temperatures of 22 °C or less with a maximum daily average of no greater than 19 °C.
- iii. Ammonia - refer to formulas and tables in rules for one-hour and four-day ammonia criteria that are pH and temperature dependent.
- iv. Turbidity below any applicable mixing zone set by the Department, shall not exceed background turbidity by more than 50 NTU instantaneously or more than 25 NTU for more than ten consecutive days.

IDAPA 16.01.01.250.02.d

Salmonid spawning: waters designated for salmonid spawning are to exhibit the following characteristics:

I. Dissolved Oxygen.

(1) Intergravel Dissolved Oxygen.

(a) One day minimum of not less than five point zero (5.0) mg/L.

(b) Seven day average of not less than six point zero (6.0) mg/L.

(2) Water-Column Dissolved Oxygen.

(a) One day minimum of not less than six point zero (6.0) mg/L or ninety percent of saturation, whichever is greater.

ii. Water temperatures of 13 °C or less with a maximum daily average no greater than 9 °C.

iii. Ammonia.

(1) One hour average concentration on un-ionized ammonia is not to exceed the criteria defined at Idaho Department of Health and Welfare Rules Section 250.02.c.iii.(1).

(2) Four day average concentration of un-ionized ammonia is not to exceed the criteria defined at Idaho Department of Health and Welfare Rules Section 250.02.c.iii.(2).

iv. Unless modified for site-specific conditions, the time periods for salmonid spawning and incubation in Table 2 apply for the indicated species.

Table 2: Annual Time Periods for Salmonid Spawning and Incubation

<u>Fish Species</u>	<u>Time Period</u>
Chinook salmon (spring)	Aug 1 - Apr 1
Chinook salmon (summer)	Aug 15 - June 15
Sockeye salmon (fall)	Sept 15 - Apr 15
Sockeye salmon	Oct 1 - June 1
Steelhead trout	Feb 1 - July 15
Redband trout	Mar 1 - July 15
Cutthroat trout	Apr 1 - Aug 1
Sunapee trout	Sept 15 - June 10
Bull trout	Sept 1 - Apr 1
Golden trout	June 15 - Aug 15
Kokanee	Aug 1 - June 1
Rainbow trout	Jan 15 - July 15
Mountain whitefish	Oct 15 - Mar 15
Brown trout	Oct 1 - Apr 1
Brook trout	Oct 1 - June 1
Lake trout	Oct 1 - Apr 1
Arctic grayling	Apr 1 - July 1

IDAPA 16.01.01.250.03.a

Water Supplies.

Domestic: waters designated for domestic water supplies are to exhibit the following characteristics:

i. All toxic criteria set forth in 40 CFR 131.36(b)(1), Column D1, revised as of December 22, 1992, effective February 5, 1993 (57 FR 60848, December 22, 1992). 40 CFR 131.36(b)(1) is hereby incorporated by reference in the manner provided in Subsection 250.07 provided, however, the standard for arsenic shall be point zero two (0.02) ug/L for Column D1 (which constitutes a recalculation to reflect an appropriate bioconcentration factor for fresh water).

ii. Radioactive materials or radioactivity not to exceed concentrations specified in Idaho Department of Health and Welfare Rules, IDAPA 16, Title 01, Chapter 08, "Rules Governing Public Drinking Water Systems."

APPENDIX B JIM FORD CREEK HABITAT SUMMARY

Prepared by Ann Storrar
Nez Perce Tribe Water Resources Division
3/3/99

Data Source:

Jim Ford Watershed was surveyed (1,817 meters total) by the Idaho Division of Environmental Quality and the Nez Perce Tribe using the Beneficial Use Reconnaissance Project (BURP) technique in 10 locations in 1995 (3 sites), 1997 (2 sites), and 1998 (5 sites). Site 5- Jim Ford Creek mouth, Site 10- Nez Perce Tribe reservation line, and Site 3- canyon downstream confluence with Meadow Creek, were located on mainstem Jim Ford Creek below the 65 foot waterfall. Sites located above the falls included: Site 1- Grasshopper Creek; Site 7- Heywood Creek; Site 8- Wilson Creek, Site 9- Winter Creek, Site 6- between falls and hydroplant, Site 4- Jim Ford Creek upstream of Weippe, and Site 2- Jim Ford Creek upstream of Weippe. Site location descriptions are included on the attached data summary sheets and shown on Figure B-1.

Significance and limitations of stream habitat data is discussed below. Reference standards were compiled from the literature and state and federal agencies to provide a basis to interpret data. In many cases more than one reference is presented for a parameter. These resources are detailed following this summary. These standards also are pertinent to the parameters evaluated in the R1/R4 Stream Survey Data Summary provided in Appendix E.

Large Woody Debris

Description of Data: In the BURP method, all large woody debris (LWD) greater than 10 cm in diameter and 1 m in length is counted within each stream reach (IDEQ 1996). Diameters and lengths are not recorded, however, and the wood count is not delineated into numbers of pieces as single, aggregates, and root wads, making the BURP LWD count not directly comparable to the Overton et. al (1995) natural conditions database or INFISH/PACFISH.

Results: All sites contained insufficient quantities of LWD as compared to INFISH/PACFISH standards. However, only the minimum LWD volume is available to compare to this standard, as diameters and lengths are not recorded in the BURP methodology. The majority of sites contained less LWD as compared to the Overton et. al. (1995) natural condition streams with the exception of Site 3 (canyon immediately downstream of Meadow Creek); Site 8 (Wilson Creek); and Site 10 (at Nez Perce Tribe reservation line). These 3 sites had amounts of wood similar to the natural condition streams.

Jim Ford Creek Watershed

IDEQ Beneficial Use Reconnaissance Program Sites

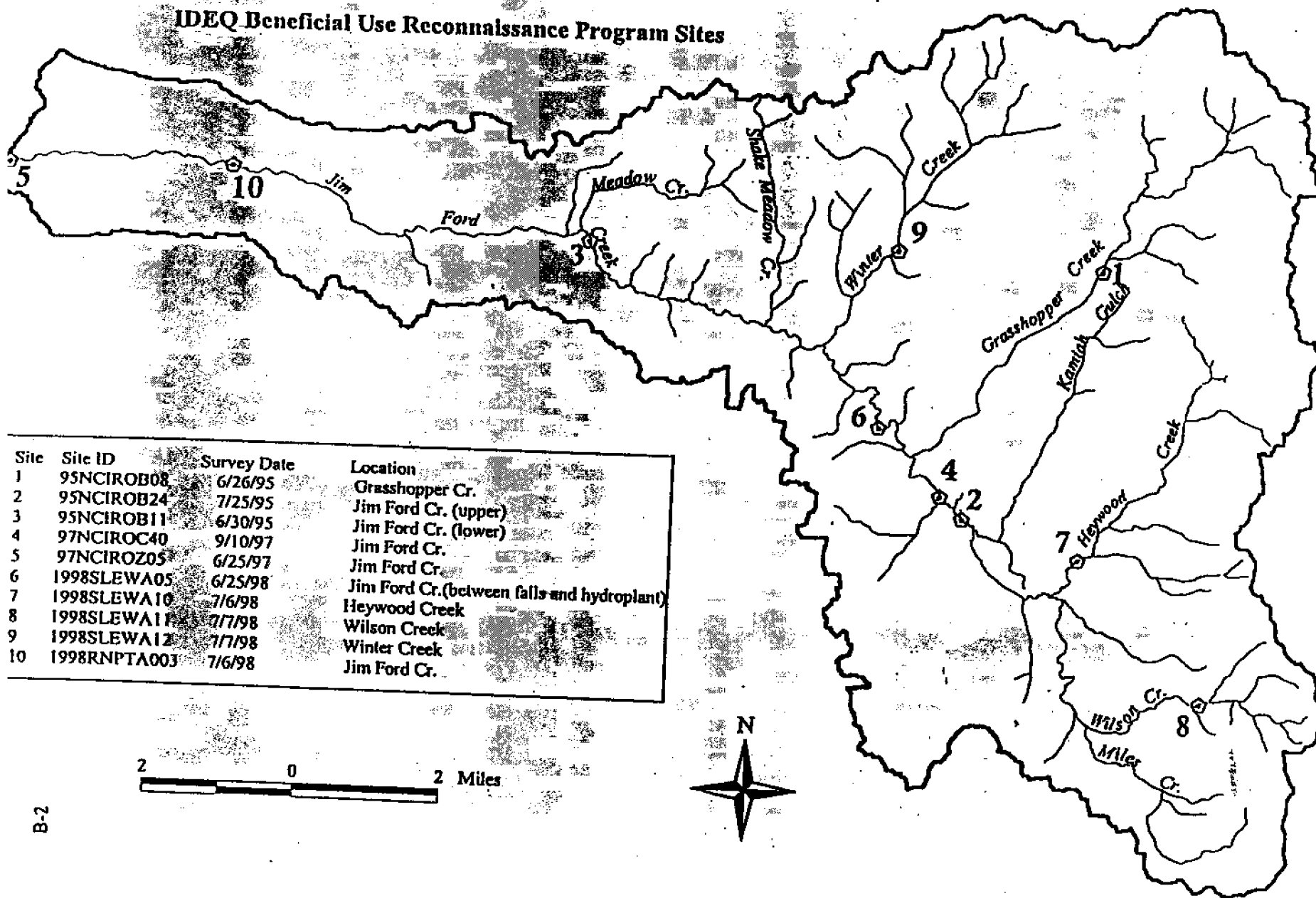


Figure B-1

Significance: LWD provides one of the most important sources of habitat for fish populations in streams by increasing habitat complexity and suitability, ensuring cover over a wide range of flow and climatic conditions (MacDonald et al. 1991). In addition, LWD provides storage sites for organic material which can provide the bulk of energy for the aquatic food chain. In the absence of woody debris, organic material and nutrients may be flushed rapidly downstream (MacDonald et al. 1991). Smaller streams have been found to contain more wood than larger systems; and riparian tree density has been positively related to LWD in streams in eastern Washington (MacDonald et al. 1991). Bilby and Wasserman (1989) found that streams with finer substrates had about half the amount of LWD compared to streams with boulder and bedrock substrates (Overton et al. 1995). Large wood has been found to influence channel meandering, bank stability, variability in channel width, and the forms and stability of gravel bars (Overton et al. 1995). Bilby (1984) determined that 80% of pools in a small stream in southwest Washington were associated with wood, and Rainville et al. (1985) found that 80% of pools in a series of small streams in the Idaho Panhandle were wood associated (MacDonald et al. 1991). Research has shown a direct relationship between the amount of LWD and salmonid production, and wood removal has been shown to reduce fish population densities.

Limitations: Difficulties are encountered when trying to quantify and count large woody debris due to subjectivity and the visibility of pieces buried in aggregates, submerged in substrate and hidden by vegetation. Overton et al. (1995) states that there is a high range of natural variability and sampling error appears to be high.

Canopy Cover

Canopy cover evaluated by the BURP methodology and compared to Plafkin et al. (1989), was below optimal for 6 of the 10 sites surveyed. It was within the optimal range for Site 5 (mouth); Site 6 (downstream hydroplant); Site 10 (Nez Perce Tribe reservation line); and Site 8 (Wilson Creek).

Pool- Riffle Ratio

Description of Data: This ratio was calculated by dividing the length of pool habitats by the length of riffle habitats. As longitudinal habitat delineation is not a part of the BURP methodology, this ratio was extrapolated from available information.

Results: The pool-riffle ratio ranged from 0.0 to 0.7 (mean 0.2) for the 10 surveyed sites, indicating reaches dominated by riffle/runs with few main channel pools. Generally a ratio of 1 is considered optimal (MacDonald et al. 1991) and IDEQ considers a range of 1 to 3 as optimal.

Significance: The pool / riffle ratio may be used to predict the streams capability of providing resting and feeding pools for fish and riffles to produce their food and support their spawning

(Platts et al. 1983). Riffles are the most productive portion of the channel for generating food, especially insects for fish (Beschta and Platts 1986). Salmon and trout use riffles for spawning because embryo and alevin survival require the specific hydraulic conditions. Riffles provide the needed water velocities to keep the substrate clean, high surface and subsurface flows for adequate transport of dissolved oxygen, and sufficient subsurface flows to remove embryo and alevin wastes (Beschta and Platts 1986). Salmon and stream dwelling trout select riffles for spawning which are typically devoid of boulders, low in fine sediments (because of the need for subsurface flow permeability), and high in gravel and small rubble (to form the protective cover over embryos which allows subsurface flows but which can still withstand most erosional velocities in the stream). Salmon and trout select spawning areas that also have high quality rearing areas nearby. Young salmon and trout use slow moving riffles with large rubble substrate for winter cover, and steelhead utilize riffles as rearing habitat (Beschta and Platts 1986).

Limitations: The common interpretation is that a ratio of 1 is optimal. Platts (1974) found the highest salmonid fish standing crops in the South Fork Salmon River drainage were in stream reaches with a pool-riffle ratio of 0.4 - 1. However, streams with high pool-riffle ratios have been shown to be high producers of salmonids (Platts et al. 1983). In some high gradient streams, riffles and pools may be difficult to discern, and are replaced by cascades and pocket waters (IDEQ 1996). MacDonald et al. (1991) state that habitat unit surveys may be relatively insensitive to land use practices. A small amount of sediment may significantly alter the bed material or residual pool volume, but not alter the size of or ratio among different habitat units.

Percent Fines

Description of Data: The BURP methodology utilizes the Wolman Pebble Count procedure to determine substrate composition. For the analysis in this report, fine sediment refers to particle sizes less than 6 mm. The BURP data for this parameter represents one Wolman Pebble Count in the reach. The dominant particle size determined by the Wolman Pebble Count is represented in bold and referred to as the "D50" in the Summary Data Tables. The "D50" particle size occurs in the size class where 50 percent of the substrate particles have a diameter less than the D50 diameter. A decrease in the D50 size is generally interpreted as an adverse effect.

Results: Percent fines (<6mm) as determined by Wolman Pebble Counts are high, well above 20% for all prairie sites (values range from 44% to 100%). Canyon sites beginning immediately downstream of hydroplant (BURP sites 3, 5, 6, and 10) are within the optimal range.

Significance: The particle size of the bed material directly affects the flow resistance in the channel, the stability of the bed, and the amount of aquatic habitat (Beschta and Platts 1986). In addition, the size of the bed material controls the amount and type of habitat for small fish and invertebrates. If the bed is composed only of fine materials, the spaces between particles are too small for many organisms (MacDonald et al. 1991). The greatest number of species are usually associated with complex substrates of stone, gravels, and sand. Coarse materials provide a variety of small niches important for juvenile fish and benthic invertebrates (MacDonald et al.

1991). The mix of coarser particles in riffles has been shown to provide the richest aquatic insect habitat (Gordon et al. 1992). Numerous studies (Brusven and Prather 1974; Bjornn 1977; and Hawkins 1983) have shown reduced invertebrate abundance with fully embedded streambed particles (Meehan and Murphy 1991). Cummins' (1974) literature review found no single factor with greater biological significance in the stream than channel substrate (Beschta and Platts 1986). Salmon and trout have evolved and adapted to the natural size distributions of channel sediments utilizing them for food and cover; and it is believed that no single size particle-size group will create the ideal environment for all phases of salmonid growth and survival. The optimum spawning substrate mix appears to be gravel containing small amounts of fine sediments as well as small rubble to support egg pockets and guard against bed erosion from floods (Beschta and Platts 1986). Fine sediments in spawning substrate have been shown to be a major cause of embryo and larval mortality. Survival is high only if the eggs receive an adequate supply of dissolved oxygen, an adequate flow of water through the gravel to supply this oxygen, and necessary flows to remove metabolic wastes (Beschta and Platts 1986). Percent emergence of swim-up fry has also been shown to be reduced by fine sediment (<6.35mm) by a number of researchers (Bjornn and Reiser 1991). When particle sizes less than 6.35mm exceed 20-25% of the total substrate, embryo survival and emergence of swim-up fry is reduced by 50% (Bjornn and Reiser 1991). Earlier studies by Bjornn found that riffles with less than 20% fine sediment supported salmon fry emergence of approximately 90%. Improper agricultural, forest harvest, road building, and grazing land management practices all tend to increase erosion and sediment delivery rates. In addition, there is some evidence that an increased deposition of fine sediment may be self-perpetuating (MacDonald et al. 1991). Reid et al. (1985) found that the onset of bedload transport may be delayed when the interstitial spaces are filled with fine sediment, and the reduced frequency of bedload transport allows for fewer opportunities for fines to be washed out during high flows (MacDonald et al. 1991).

Limitations: While the Wolman Pebble Count is useful for characterizing the substrate overall, it is not the preferred technique for fine sediment analysis, due to individual sampling biases.

Fish Density

Results: Jim Ford Creek rainbow-steelhead density of 0.02/m² (Kucera 1984) was the lowest of 10 NPT reservation tributaries to the Clearwater River sampled (values ranged from 0.02 to 0.22/m²). These may be considered wild/natural as no stocking of steelhead or chinook has occurred in Jim Ford Creek (Rosenberg 1999, Cochenauer 1999, and Kucera 1999). Recent NPT electrofishing (1998) found a density of 0.01/m² and at least 2 age classes of wild/natural rainbow/steelhead.

Chinook densities were 0.005/m² (NPT 1998) and 80-110 mm in length (age 0).

Other species found in watershed include dace, sculpin, northern squawfish, chiselmouth, shiner, pumpkinseed, bullhead catfish and sucker. Dace, shiner, pumpkinseed, and bullhead catfish are found above the falls.

Significance: Fish populations are a result of the physical, biological, and chemical factors surrounding them, and through their link to the trophic levels below them, provide understanding of total ecosystem functioning (Platts et al. 1983). Size, structure, and growth rates of fish populations allow insight into the habitat conditions that existed in the past 2 to 10 years. Year class strength is usually set in the early life history of fish, which allows known habitat conditions to be followed while determining reactions of fish to these conditions (Platts et al. 1983). Salmonid species generally have the most economic importance and stringent habitat requirements, thus most monitoring activities focus on them (MacDonald et al. 1991). Land management can affect a wide variety of physical and biological parameters critical to fish reproduction, rearing, and growth, including temperature, substrate, primary productivity, peak runoff, low flows, and macroinvertebrate populations. In some cases adverse effects for one species may benefit another. Research has demonstrated the need to evaluate management impacts by species and life cycle stage, and not rely on single indices such as the total number of fish (MacDonald et al. 1991). Generally fewer fish species occur in undisturbed streams and lakes in the Pacific Northwest than in the Midwest or Southeast, which impairs the use of diversity indices as indicators of water quality. However, the number of native species may be a sensitive measure of the deterioration of fish habitat (MacDonald et al. 1991).

Limitations: Sampling of fish populations must be done accurately because freshwater fish have wide fluctuations in year-class strength, and sampling techniques have different advantages and disadvantages. Electrofishing may be affected by stream conductivity, temperature, depth, and clarity of water.

Width to Depth

Description of Data: The BURP data summarizes the wetted width to depth ratio.

Results: Mean width to depth ratios were higher at Site 5 (mouth), Site 3 (Jim Ford canyon downstream of Meadow Creek), and Site 6 (between hydroplant and falls) than values Overton et al. (1995) found for natural condition streams with similar geology and gradients. These sites in addition to Site 1 (Grasshopper Creek) and Site 10 (Nez Perce Tribe reservation boundary) also fail to meet INFISH/PACFISH standards of a width to depth ratio < 10 , and IDEQ optimal ratio < 7 . The remaining four sites evaluated generally met all reference targets.

Significance: Sediment accumulation in stream channels reduces stream depth (MacDonald et al. 1991). Large width to depth ratios are often a result of lateral bank erosion due to increased peak flow, increased sediment availability, and eroding banks due to loss of streamside vegetation (Overton 1995, and Beschta and Platts 1986). MacDonald et al. (1991) cites major adverse effects of the biological community with a decrease in channel depth and an increase in channel width. A decrease in depth reduces the number of pools (Beschta and Platts 1986), and this will reduce certain types of fish habitat. An increase in stream width will lead to an increase in net solar radiation and higher summer water temperatures (Beschta et al. 1987). The combination of shallower pools and increased solar radiation can greatly affect the suitability of the stream for

coldwater fish. An increase in stream width also results in a reduced riparian zone which decreases its ability to capture sediment and nutrients (MacDonald et al. 1991), and as increases in channel width result from bank erosion, a corresponding increase in sediment inputs to the channel occur. Changes in width or the width-depth ratio can be used as an indicator of change in the relative balance between sediment load and sediment transport capacity (MacDonald 1991).

Limitations: Streams of uniform depth and width may have insignificant amounts of fish rearing habitat, yet others with the same average width to depth ratio may have shallow riffles interspersed with deep pools and overhanging banks which may provide abundant rearing habitat (Beschta and Platts 1986).

Pool frequency

Results: As longitudinal habitat delineation is not a part of the BURP methodology, this parameter was extrapolated from available information and could not be evaluated precisely. Five sites exceeded the number of pools in 100 meters as compared to the Overton et al. (1995) natural condition streams of similar widths, gradients and geology. Sites with fewer pools included: Site 5 (mouth), Site 6 (between hydroplant and falls), Site 7 (Heywood Creek), and Site 8 (Wilson Creek). Six of the 9 sites evaluated contained fewer pools as compared to INFISH/PACFISH interim objectives. The remaining sites: Site 3 (Jim Ford canyon immediately downstream of Meadow Creek); Site 4 (prairie above Weippe); and Site 10 (mouth of Jim Ford Creek) had adequate pool frequencies compared to this standard.

Significance: Pools are the major stream habitat of most fish. Salmonids often require backwater or dammed pools with water moving at slow velocities to permit survival of harsh winter conditions, and pools of all shapes, sizes, and quality are needed to support different age classes. (Beschta and Platts 1986). Juvenile fish need shallow, low quality pools that other fish will not use, until increased growth allows them to eventually compete, without predation stress, in the higher quality pools which have better food supplies and winter rearing habitat. Thus fish utilize a combination of pools for year-round rearing. Deep, slow-velocity pools with large amounts of overhanging vegetation support the largest and most stable fish populations (Beschta and Platts 1986).

The frequency and size of pools is dependent on stream size, gradient, confinement, flow, sediment load, and large woody debris (Overton et al. 1995). Pools characterized by low flow velocities (backwater or dammed pools) are particularly susceptible to infilling with sediment, thus the depth, area, or volume of these pools can serve as indicators of coarse sediment loading due to land-management activities (MacDonald et al. 1991). Overton et al. (1995) found fewer deep pools in an intensely timber-managed watersheds compared to a nontimber-managed watershed. A decrease in the amount of large woody debris may lead to a reduction in the number and size of pools, and a change in peak flows will alter the ability of a stream to transport sediment, altering pool measurements (MacDonald et al. 1991). Landslides, debris flows, and

other mass movements typically result in a loss of pool area and volume (MacDonald et al. 1991).

Limitations: The change from pools to runs or glides is one point on a continuum leaving the dimensions of a pool a matter of professional judgement. In larger streams with deeper pools, direct measurements are difficult and estimates may be necessary. Pool depth, pool area, and pool volume are all flow dependent, thus comparisons between surveys should consider the discharge at the time of data collection.

Bank Stability

Description of Data: The BURP methodology follows the approach of Platts et al. (1983) including measuring and proportioning banks into four stability classes: mostly covered and stable (non erosional), mostly covered and unstable (vulnerable), mostly uncovered and stable (vulnerable), and mostly uncovered and unstable (erosional). The streambank is envisioned as that part of the channel which would be most susceptible to erosion during high water; therefore it represents the steeper-sloped sides of the stream channel. Banks are considered unstable if they show indications of breakdown, slumping or false bank, fracture, and steepness over 80 degrees with erosion.

Results: Bank stability was optimal at all sites evaluated, ranging from 70-100 % stable. Five sites were rated at 100% stable. Site 5 (mouth) and Site 7 (Heywood Creek) were rated the lowest at 70% stable. Also Site 1 (Grasshopper Creek) had a low left bank rating of 47%, while the right bank rated 100%. Platts et al. (1983) rates bank stability of 80% and above as excellent, and this value meets interim objectives INFISH/PACFISH (1995).

Significance: Bank stability is rated by observing existing or potential detachment of soil from upper and lower stream banks and its potential movement into the stream. Steeper banks are generally more subject to erosion and failure, and streams with poor banks will often have poor instream habitat (Plafkin et al. 1989). The adverse impact from an eroding streambank can be much greater than the adverse effects of a comparable area of eroding hillside because sediment is delivered directly to the channel (MacDonald et al. 1991). Protection from erosion is provided by plant root systems as well as by boulder, cobble, or gravel material (Plafkin et al. 1989). A study by Platts (1981) found that where channel bank and riparian vegetation were in good condition, the channel handled flooding without habitat damage (Beschta and Platts 1986). Channel bank conditions are closely linked to the quality of fish habitat, affecting fish populations and providing important rearing habitat for fish. Detrimental changes in the productivity and composition of riparian vegetation can increase stream channel width, decrease stream depth, increase stream temperature in summer and decrease it in winter, and decrease food supply (Beschta and Platts 1986). These factors may individually or collectively reduce fish populations. The elimination of streamside vegetation and collapsing of banks were found to be principal factors in the decline of native trout populations throughout many western streams (Beschta and Platts 1986). Bank stability is an important indicator of watershed condition and

can directly affect designated uses.

Limitations: Some limitations related to assessing the degree of bank stability include: the lack of accuracy and precision involved in visual estimates; the inability to identify specific causes of instability; varying sensitivity of stream reaches; and the difficulty of separating natural and management impacts. According to Platts (1981), grazing has the most direct and obvious impact on bank stability, and this may mask other impacts (MacDonald et al. 1991). Discharge and sediment yield tend to be controlled by upslope processes, so the linkage to bank stability is not immediately obvious, however, bank stability may be most useful as a quick indicator of shift in the equilibrium of the stream system (MacDonald et al. 1991).

Macroinvertebrates

Description of Data: Macroinvertebrates are collected as part of the BURP methodology from 3 separate riffles per site and combined as one sample, using a modified Hess stream bottom sampler with 0.5 mm mesh. The first 500 individuals are counted and identified to species. Seven metrics are calculated for the IDEQ (1996) Macroinvertebrate Biotic Index (MBI) including: percent EPT, Hilsenhoff Biotic Index (HBI), percent scrapers, percent dominance, EPT Index, Taxa Richness, and the Shannon H' Diversity Index. Each metric measures a different component of community structure and a different range of sensitivity to pollution stress. The MBI is calculated based on these metric values compared to the Northern Rockies Ecoregion reference levels representing the best conditions for this region. The MBI is used to determine the level of macroinvertebrate assemblage impairment.

The macroinvertebrate data may also be evaluated using Plafkin's (1989) Rapid Bioassessment Protocols approach for the seven metrics listed above. According to Plafkin (1989) metrics based on standard taxa richness and EPT indices (% EPT, EPT index, and taxa richness), differences of 10-20% are considered nominal, thus a value within 80% of the reference condition would be considered nonimpaired for that metric. For this analysis, the Northern Rockies Ecoregion values are used as references for comparison. Northern Rockies Ecoregion values are generally considered to be high (Rabe 1997) and should not be weighted as heavily as the regional reference, however at this time one has not been established. Percent dominance is evaluated based on percent contribution, not percent comparability to a reference site, with < 20 % dominance considered optimal (Plafkin 1989). The HBI score is evaluated as a ratio of the reference site to study site x 100, with greater than 85% considered optimal (Plafkin 1989). Shannon's H' Diversity Index and percent scrapers rate as optimal if values are within 80% of the reference site value.

All sites evaluated in the Jim Ford Creek watershed fall within 1st through 3rd order streams. First through third order streams as viewed in the river continuum concept (Vannote et al. 1980) are heavily canopied, light-limited heterotrophic systems with rocky substrates. Dominant macroinvertebrate species in lower order streams include shredders and collectors, with a smaller percentage of grazers and predators (Ward 1992).

Results: Available data is limited to 3 sites: Site 1 (Grasshopper Creek), Site 2 (Jim Ford prairie above Weippe), and Site 3 (Jim Ford canyon downstream of Meadow Creek). The MBI for Site 1 (3.09) and Site 2 (2.62) indicate impairment, while Site 3 (3.64) is unimpaired by IDEQ guidance (MBI greater than or equal to 3.5).

All indices varied more than 20% from Northern Rockies Ecoregion values with the exception of taxa richness at Site 3. These results indicate lower water quality (% EPT, and EPT index), a higher number of pollutant tolerant species (HBI index), and suboptimal biodiversity due to a lack of habitat diversity or suitability (taxa richness and Shannon's H' index). It has been shown that total taxa richness and richness of ephemeroptera, plecoptera, and trichoptera easily separates disturbed sites from less disturbed sites, declining as disturbance increases (Fore, Karr, and Wisseman 1996). These indices were low at the 3 sites with the exception of taxa richness at Site 3, as mentioned above. Percent dominance for Site 1 (41%), and Site 3 (31%) exceed the optimal value of 20 % indicating a community dominated by few species reflecting environmental stress. Site 2, however, had an unimpaired value of 20 % dominance.

Significance: Macroinvertebrates have several major roles in aquatic ecosystems as consumers at intermediate trophic levels. They graze on periphyton (attached algae) and feed on terrestrial organic matter that falls in the stream. Other macroinvertebrates are predators and filter feeders (MacDonald et al. 1991). Macroinvertebrates are influenced by both bottom up and top down forces in streams and have important effects on nutrient cycles, primary productivity, decomposition, and translocation of materials (Wallace and Webster 1996). They also constitute an important source of food for numerous fish, and unless outside energy inputs are greater than instream food resources, effective fisheries management must account for fish-invertebrate interactions with resources and habitats (Wallace and Webster 1996).

Platts (1983) and Rosenberg and Resh (1993) note several characteristics which make macroinvertebrates useful indicators of water quality: they are abundant in most streams; the large number of species provides a spectrum of responses to environmental stresses; their sedentary nature allows for site specific analysis of pollutant or disturbance effects; and their life spans of several months to a few years allow them to be used as indicators of past environmental conditions. In addition, the sensitivity of aquatic insects to habitat changes and water quality changes have shown them to be more effective indicators of stream impairment than chemical measurements (MacDonald et al. 1991).

Recent studies by Fore, Karr and Wisseman (1996) determined 10 attributes of macroinvertebrate assemblages to be reliable indicators of disturbance (logging, road construction, agricultural practices). Among their findings, taxa richness and richness of Ephemeroptera, Plecoptera, and Trichoptera species separated the best sites from the poor sites and in general declined as disturbance increased. Other studies have shown that while a decrease in riparian canopy through logging may increase total abundance, species diversity is reduced. Fine sediment increases have also been shown to decrease aquatic insect populations (MacDonald et al. 1991).

Limitations: Disadvantages of monitoring macroinvertebrates include a relatively high degree of

variability within or between sites, local or regional variations in the sensitivity of given organisms to stress, and the need for specialized taxonomic expertise (MacDonald et al. 1991). Sampling should be replicated at sites and stratified by habitat type due to variability with depth, current speed, and substrate character. The BURP macroinvertebrate samples were obtained at base flows (late July-August), however, flows differed between years which could contribute to variability, and samples were combined at sites, thus they are not replicates. Sampling variability may also result from the sampling device operations, physical features of the habitat, laboratory sorting procedures, and biological features of the study population (Platts et al. 1983).

Road Density

Data: Road density in lower Jim Ford is 4.58 mi/sq. mile (IDL 1999). This is ranked as low quality (NMFS et al. 1998).

Significance: Roads are one of the greatest sources of habitat degradation in managed watersheds, especially when they are within the riparian area. Roads significantly elevate on-site erosion and sediment delivery for their lifespan and increase the frequency of mass failures in mountainous terrain. They have been shown to disrupt subsurface flows and increase peak flows. Roads within riparian areas reduce shading and large wood debris sources. These effects of roads degrade habitat by increasing fine sediment, reducing pool volume, increasing channel width and exacerbating seasonal temperature extremes (Columbia Inter-Tribal Fish Commission 1994).

Limitations: The road density figure does not take into consideration road quality.

Jim Ford Creek Data Summary

12/12/94

Jim Ford Creek—10 sites—Benthic Use Reconnaissance Data NPT and IDEQ

Site	Site ID	Survey Date	Location	Elevation (ft)	Dischg (cfs)	Rch length (m)	Grad (%)
1	95NCIROB08	6/26/95	Grasshopper Cr.	3313	1.11	100	2.0
2	95NCIROB24	7/25/95	Jim Ford (upper) Cr.	3018	nd	100	nd
3	95NCIROB11	8/30/95	Jim Ford Cr. (lower)	1969	7.50	326	1.0
4	97NCIROC40	8/10/97	Jim Ford Cr.	2854	nd	122	nd
5	97NCIROZ05	8/25/97	Jim Ford Cr.	1080	8.46	125	1.5
6	1998SLEWA05	8/25/98	Jim Ford Cr. (blwn falls and hydroplant)	2133	1.20	386	2.0
7	1998SLEWA10	7/18/98	Heywood Creek	3514	1.23	121.5	1.0
8	1998SLEWA11	7/7/98	Wilson Creek	3029	0.71	150	1.0
9	1998SLEWA12	7/7/98	Winter Creek	3117	0.39	152	1.5
10	1998RNPTA00	7/8/98	Jim Ford Cr.	1200	22.12	235	2.0

Site	Region	Mean width (m)	Mean depth (m)	Mean wtd
1	C	2.29	0.10	22.9
2	C	nd	nd	nd
3	C	11.68	0.18	73.0
4	C	7.87	0.59	13.3
5	F	7.25	0.18	40.3
6	B	6.1	0.19	42.8
7	C	2.8	0.51	5.5
8	C	1.5	0.25	8
9	C	11.98	0.17	11.5
10	B	10.3	0.5	20.8

Site	Pool (m)	Run (m)	P/R Ratio
1	41	59	0.69
2	100	290	0.00
3	31	295	0.11
4	122	0	0.00
5	4	121	0.03
6	76	310	0.28
7	30	91.8	0.33
8	23	127	0.18
9	49	102.5	0.48
10	33.8	201.2	0.17

Canopy Cover
Mean % cover

1
0
13
33
61.5
55.5
4
36.5
5
41.5

Pool Characteristics				Pool Characteristics	
Site	Wetted width	# pools	Reach Length (m)	# pieces*	Minimum Volume (m ³)
1	2.28	4	100	1	0.01
2	nd	1	100	0	0.00
3	11.88	8	328	20	0.18
4	7.87	4	122	0	0.00
5	7.25	1	125	1	0.01
6	8.1	4+7	398	11	0.08
7	2.8	3	121.5	1	0.01
8	1.5	77	150	38	0.30
9	1.98	6	152	8	0.06
10	10.3	4	235	20	0.18

* # of pieces > 10 cm diameter and 1 m in length

Residual Pool Depth (m)						
Site	Pool 1	Pool 2	Pool 3	Pool 4	Pool 5	Pool 6
1	nd					
2	nd					
3	nd					
4	0.40	0.65	0.88			
5	0.48					
6	0.15	0.45	0.55	0.55		
7	0.8	1.05	1.4			
8	0.6	0.8	0.15	0.2		
9	0.5	0.5	0.08	0.25		
10	1.4	0.65	0.60	0.85		

Residual Pool Volume (m ³)						
Site	Pool 1	Pool 2	Pool 3	Pool 4	Pool 5	Pool 6
1	nd					
2	nd					
3	nd					
4	153	210	258			
5	5.18					
6	1.62	38.5	12.1			
7	8.1	42.5	100.8			
8	35.5	11.2	1.14	1.00		
9	18.38	15	0.84			
10	138.6	20.8	47.52	49.73		

Bank Stability (m)		
Site	Left Bank	Right Bank
1	47	100
2	100	100
3	100	100
4	100	100
5	70	70
6	100	100
7	70	70
8	90	90
9	90	90

Site	0-1 mm	1-2.5 mm	2.5-6 mm	6-16 mm	16-31 mm	31-64 mm	64-128 mm	128-256 mm	256-512 mm	512-1024 mm	1024 > mm	D50 (mm)	% Tot fines
1	0.60	0.03	0.05	0.13	0.06	0.05	0.04	0.03	0.00	0.00	0.00	0-1	88
2	all silt and sand		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0-2.5	100
3	0.00	0.00	0.00	0.01	0.01	0.13	0.36	0.40	0.05	0.02	0.03	64-128	0
4	0.21	0.61	0.00	0.00	0.04	0.12	0.00	0.01	0.00	0.00	0.00	1.1-2.5	82
5	0.00	0.00	0.01	0.01	0.01	0.23	0.33	0.29	0.01	0.00	0.00	064.1-128	1
6	0.00	0.00	0.02	0.02	0.06	0.12	0.13	0.08	0.13	0.14	0.31	256.1-512	2
7	0.58	0.35	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0-1	100
8	0.72	0.19	0.05	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0-1	96
9	0.28	0.08	0.08	0.04	0.15	0.20	0.12	0.02	0.02	0.00	0.00	15.1-31	44
10	0.01	0.03	0.00	0.01	0.04	0.20	0.22	0.30	0.16	0.06	0.01	64.1-128	4

Site: Bjorn and Reiser 1991:

Species	% Fines < 6.35 mm	% Embryo Survival
Cutthroat	20	50
Rainbow	30	50
Kokanee	33	50
Cutthroat	10	75
Rainbow	20	75
Kokanee	25	75

See Temperature Summary: 10 thermographs throughout watershed in 1988

Site	% EPT	HBI	XSCR	EPT Index	Taxa Rich	% Dom	Shan H	MBI
N Re	94	0.5	85	38	28	28	1.08	
1	47.00	4.50	1.00	10.00	21.00	41.00	0.80	3.08
2	1.00	6.50	19.00	1.00	20.00	20.00	0.70	2.62
3	35.00	4.30	6.00	16.00	33.00	31.00	1.05	3.84
4	nd							
5	nd							
6	nd							
7	nd							
8	nd							
9	nd							
10	nd							

Site	< 100 mm	100-200 mm	200-300 mm	Seconds	Approx Density	Add'l Species
1	79 dace			175		
2	nd					
3	12 SH	8 RBT/SH	1 bass	1 pass (7 Sec)		
4	3 dace			?		
5	4 RBT			1238		
6	no e fish data					238 dace, 77 sculpin, 13 N. Squawfish
7	no e fish data					5 shiner, 1 pumpkinseed
8	no e fish data					16 sculpin, 18 sucker, 4 squawfish
9	no e fish data					observed YOY / dace
10	7 SH, 12 chink	19 RBT/SH				observed YOY / dace

* RBT = rainbow trout

* SH = steel head

IDFG 1991 River and Stream Investigations:

Frequency distribution of wild trout densities within individual sampling sites in Regions 6 and 6 as estimated by electrofishing. All streams less than 10 meters wide.

# of streams	Density (fish / 100m ²)
20	0-6
29	6.1-15
21	15.1-30
18	30.1-45
13	45.1-60
8	60.1-75
4	75.1-90
5	90.1-105
3	105.1-120
1	120.1-135
1	135.1-150
1	150.1-165

Ed Schreiner (IDFG) Pers. Comm.

Densities can be highly variable.

Data analysis may take average density of all transects even those with 0 fish, or average densities of fish containing transects

General densities for stream (the upper Lapwai)

Low	4 fish / 100m ²
Medium	4-8 fish / 100 m ²
High	> 8 fish / 100 m ²

References

- Beschta, Robert L. and W.S. Platts. 1986. Morphological features of small streams: significance and function. *Water Resources Bulletin*. American Water Resources Association, vol. 22, no. 3.
- Beschta, R.L., R.E. Bilby, G.W. Brown, L.B. Holtby, and T.D. Hofstra. 1987. Stream temperature and aquatic habitat: fisheries and forestry interactions. In: E.O. Sago and G.W. Cundy, eds. *Streamside Management: Forestry and Fisheries Interactions*. Institute of Forest Resources. University of Washington. Seattle, Washington.
- Bilby, R.E. 1984. Removal of woody debris may affect stream channel stability. *Journal of Forestry*, vol. 82, no. 10.
- Bilby, R.E. and L.J. Wasserman. 1989. Forest practices and riparian management in Washington State. In: Greswell, R.E., eds. *Billings, MT: U.S. Bureau of Land Management, Riparian Resource Management*.
- Bjornn, T.C. and W.R. Meehan. 1991. Influences of forest rangeland and management on salmonid fishes and their habitat. Chapter 3: Salmonid distributions and life histories. *American Fisheries Society Special Publication*, vol. 19.
- Bjornn, T.C. and D.W. Reiser. 1991. Influences of forest rangeland and management on salmonid fishes and their habitat. Chapter 4: Salmonid distributions and life histories. *American Fisheries Society Special Publication*, vol. 19.
- Brusven, M.A., and K.V. Prather. 1974. Influence of stream sediments on distribution of macrobenthos. *Journal of the Entomological Society British Columbia* 71: 25-32.
- Carlson, J.Y., C.W. Andrus, and H.A. Froehlich. 1990. Woody debris, channel features and macroinvertebrates of streams with logged and undisturbed riparian timber in Northeastern Oregon, U.S.A. *Canadian Journal of Fisheries and Aquatic Science*, vol. 47.
- Chapman, D.W. 1988. Critical review of variables used to define effects of fines in redds of large salmonids. *Transactions of the American Fisheries Society*, vol. 117, no. 1.
- Cochenauer, Tim. 1999. Personal telephone communication between Tim Cochenauer of IDFG Lewiston Office and Ann Storrar of NPT Water Resources Office in Lapwai.
- Columbia River Inter-Tribal Fish Commission. 1994. A coarse screening process of the effects of land management activities on salmon spawning and rearing habitat in ESA consultations. Technical Report 94-4.

Cummins, Kenneth W. 1974. Structure and function of stream ecosystems. *Bioscience*, vol. 24, 631-641.

Cummins, Kenneth W., S.V. Gregory, W.A. McKee, F.J. Swanson. 1991. An ecosystem perspective of riparian zones. *Focus on Links Between Land and Water*. *Bioscience*, vol. 41.

Fore, L.S., J.R. Karr, R.W. Wisseman. 1996. Assessing invertebrate responses to human activities: evaluating alternative approaches. *Journal of the North American Benthological Society*, vol. 15, no.2.

Gordon, N.D. et al. 1992. *Stream Hydrology: An introduction for ecologists*. John Wiley & Sons, New York, NY.

Hawkins, C.P., M.L. Murphy, N.H. Anderson. 1982. Effects of canopy, substrate composition and gradient on the structure of macroinvertebrate communities in Cascade Range Streams of Oregon. *Ecology*, vol. 63, no.6.

Hawkins, C.P., and J.R. Sedell. 1981. Longitudinal and seasonal changes in functional organization of macroinvertebrate communities in four Oregon streams. *Ecology*, vol. 62, no.2.

[IDEQ]. Idaho Division of Environmental Quality. 1996. Water body assessment guidance. A stream to standards process. Prepared for State of Idaho, Watershed Monitoring and Analysis Bureau.

[IDL] Idaho Department of Lands. 1999. Jim Ford Creek cumulative watershed effects assessment. Idaho Department of Lands Coeur d'Alene, Idaho.

Karr, J.R., K.D. Fausch, P.L. Angermeier, P.R. Yant, and I.J. Schlosser. 1986. Assessing biological integrity in running waters: a method and its rationale. *Illinois Natural History Survey*. Special Publication 5.

Kucera, P.A. 1984. A biological and physical inventory of the streams within the Nez Perce Reservation. Report 82-1. Nez Perce Tribe Fisheries Division. Lapwai, Idaho.

Kucera, P.A. 1999. Personal oral communication between P.A. Kucera of NPT Fisheries Division and Ann Storrar of NPT Water Resources Division.

APPENDIX C

**JIM FORD CREEK
CUMULATIVE WATERSHED EFFECTS ASSESSMENT**

August 1999

**Assessment conducted under the auspices of the
Idaho Forest Practices Act**

**Report prepared by
Tom Dechert
Idaho Department of Lands
Coeur d'Alene, Idaho**

Executive Summary

Jim Ford Creek is a third order stream draining into the Clearwater River of north-central Idaho. It had been identified as a Stream Segment of Concern and was subsequently placed on the 303(d) list by the U.S. Environmental Protection Agency (USEPA) for beneficial uses being threatened by sediment, nutrients, temperature, dissolved oxygen, pathogens, ammonia, oil and grease, and flow and habitat alteration. To address these and other concerns, a Watershed Advisory Group (WAG) was established to direct the development of a problem assessment and Total Maximum Daily Load (TMDL) for the watershed. In 1997, the WAG asked the Idaho Department of Lands (IDL) to complete a Cumulative Watershed Effects (CWE) assessment of forested portions of the drainage.

The IDL conducted the CWE assessment in 1997 and 1998 following the methods of the *Forest Practices Cumulative Watershed Effects Process of Idaho* (IDL, 1995). The CWE assessment process divided the Jim Ford Creek watershed into nine subwatersheds. The assessments were run on the subwatersheds then grouped up to the whole Jim Ford Creek watershed.

The results of the analyses indicate that current forest management practices under Idaho's Forest Practices Act coupled with the Site Specific Best Management Practices established under Idaho's Stream Segment of Concern Antidegradation Agreement of the Jim Ford Creek watershed upstream from the town of Weippe are not causing any adverse effects on a cumulative basis. The results of the Idaho Division of Environmental Quality Beneficial Uses Reconnaissance Surveys (BURP) indicate that beneficial uses are not being fully supported upstream of Weippe. This CWE assessment concludes that forest practices are not contributing any excessive amount of the pollutants of concern that would lead to not full support, and recommends that further analysis be done as part of the TMDL to determine the source of the pollutants.

An adverse condition exists for stream temperature in the stream reaches below the falls and downstream from Weippe. Because the best resolution to the adverse condition would involve all the subwatersheds upstream from the lower reaches, and since a TMDL addressing stream temperature problems is being developed by the WAG for the whole watershed, the development of site-specific CWE Management Prescriptions (CWEMPs) is being postponed until an implementation plan for the TMDL has been approved. At that time CWEMPs will be developed incorporating the applicable parts of the TMDL implementation plan, and meeting the requirements of Idaho's Forest Practices Act. In the interim, no forest practice shall reduce shading in the Stream Protection Zone (SPZ) of the lower reaches of Jim Ford Creek.

I. INTRODUCTION

The Jim Ford Creek Watershed Advisory Group (WAG) requested the Idaho Department of Lands to conduct a Cumulative Watershed Effects (CWE) assessment of the Jim Ford Creek watershed. The WAG requested CWE as part of their effort to complete a problem assessment and Total Maximum Daily Load (TMDL) of the watershed in response to Jim Ford Creek having been listed by the USEPA as water quality limited. The Forest Practices Cumulative Watershed Effects Process for Idaho is designed to assess single 6th order watersheds less than about 20,000 acres in size. This report for Jim Ford Creek addresses the larger 5th order Jim Ford Creek watershed by accumulating data from individual 6th order watershed assessments. CWE data for the individual 6th order subwatersheds is presented and then discussed as they relate to the whole 5th order watershed.

A. Watershed Description

The Jim Ford Creek watershed is located around the town of Weippe, Idaho, and approximately 20 miles southeast of Orofino, in Clearwater County, Idaho (Figure 1). The Jim Ford Creek drainage contains 65,838 acres used primarily for forestry, with some agriculture, grazing, recreation, and urban/suburban development. Land ownership is distributed among the Nez Perce Tribe, the Idaho Department of Lands, Potlatch Corporation, and small private owners (Figure 1).

Bedrock of the Jim Ford Creek drainage is primarily Tertiary Columbia River basalt with small areas of Mesozoic granitics and Precambrian metasediments along the eastern border. The granitic and metasedimentary rocks support a hilly to mountainous terrain. The soils on this terrain vary greatly in thickness and are dominantly derived from decomposed bedrock, loess and volcanic ash. In the basalt areas, the terrain occurs as a gently rolling plateau top or a steep and strongly dissected canyon where Jim Ford Creek dives down to the Clearwater River, some 2000 ft below the plateau. A nick point of more resistant basalt just to the west of Weippe forms a falls which mark the beginning of the canyon. Most of the gentle plateau top terrain and some of the eastern hills have surficial layers of loess and volcanic ash. Drainages on the plateau are floored by retransported silt washed off the uplands. The canyonlands are characterized by basalt rock outcrop and colluvial slopes with various thicknesses of soils.

Jim Ford Creek is a third order tributary to the Clearwater River. The drainage is oriented in a northwesterly direction with Jim Ford Creek generally flowing from southeast to northwest. Elevation ranges from 1050 feet at the confluence of Jim Ford Creek and the Clearwater River to 4068 feet on Browns Creek Lookout. The drainage pattern is different on each of the three dominant geomorphic settings: the eastern hills have a well-developed, fine dendritic pattern, the plateau top exhibits an irregular, meandering pattern, while the canyon has a moderately coarse, semi-trellis pattern. Stream gradients are significantly different on the three terrains, with the canyonlands being very steep to precipitous, the eastern hills being intermediate, and the plateau top having a very low gradient.

The area is characterized by warm, dry summers and cold winters, with an average annual precipitation ranging from 24 inches at the lower elevations to near 40 inches at the higher elevations. The majority of precipitation occurs as winter snowfall and spring rain. High-volume runoff occurs during spring snowmelt and major rain-on-snow events.

Vegetation varies with elevation and aspect. Strong south to west facing slopes at the lower elevations in the canyon support forbs and grasses and areas of Ponderosa Pine savannah. On north sloping canyonlands and with increasing elevation, forested stands become more dense with a greater number of conifer species. The presence of Douglas fir, grand fir, larch, lodgepole pine, cedar and white pine increases with increasing elevation and effective precipitation. A significant portion of the plateau top has been converted to dryland agriculture and rangeland.

B. Stream Segment of Concern: Antidegradation

Jim Ford Creek was designated a Stream Segment of Concern (SSOC) on May 11, 1993, pursuant to Idaho's Antidegradation Agreement. No Local Working Committee (LWC) was required; however, revisions pertaining to site specific best management practices (SSBMPs) for forestry were reached after consultation with other agency resource management personnel. The IDL Director approved the SSBMPs on June 6, 1991 (Appendix 1).

C. Beneficial Uses

The USEPA determined that sediment, nutrients, dissolved oxygen, pathogens, ammonia, temperature, oil and grease, and flow and habitat alterations threaten Jim Ford Creek's beneficial uses [U.S. Environmental Protection Agency, Region 10: 303(D) list for Idaho, Appendix C, October 7, 1994].

Although most of the data analyses are not complete at this time, the Idaho Division of Environmental Quality (DEQ) 1996 Beneficial Use Reconnaissance Project (BURP) assessments and other work indicate that water quality in Jim Ford Creek is indeed impaired, and that beneficial uses are not being fully supported.

D. Goals of this Assessment

At the request of the WAG, a Cumulative Watershed Effects (CWE) assessment of the forested portions of Jim Ford Creek was conducted by IDL and other interested parties to: 1) develop an understanding of the inherent hazards of the landscape within the Jim Ford Creek watershed, 2) document the current conditions within the forested portions of the watershed relevant to hydrologic processes and the disturbance history, and 3) develop a control process that will ensure that the forested portion of the watershed is managed to protect water quality so that beneficial uses are supported.

II. CUMULATIVE WATERSHED EFFECTS METHODOLOGY

Complete CWE assessments for six of the nine subwatersheds within the Jim Ford Creek watershed were conducted in 1997 and 1998 by personnel from IDL, DEQ, Potlatch Corporation, and the Idaho Soil Conservation Commission. The subwatersheds assessed are listed in Table 1 and shown in Figure 1. The Jim Ford Creek CWE assessment followed the standard procedures of the *Forest Practices Cumulative Watershed Effects Process for Idaho* (Idaho Department of Lands, April 1995).

Table 1. Jim Ford Creek subwatersheds

Basin No.	Subwatershed No.	Creek Name	Acreage	CWE Assessment
17060306	1401	Lower Jim Ford sidewalls	17984	Complete 1998
17060306	1402	Shake Meadow	1951	Partial 1998
17060306	1403	Winter	7282	Complete 1998
17060306	1404	Upper Jim Ford sidewalls	7151	Partial 1998
17060306	1405	Middle Jim Ford sidewalls	2688	Partial 1998
17060306	1406	Karniah Gulch	2690	Complete 1997 & 1998
17060306	1407	Grasshopper	10586	Complete 1998
17060306	1408	Heywood	7337	Complete 1998
17060306	1409	Miles/Wilson	8167	Complete 1997 & 1998

Idaho Code Section 38-1303 (17) defines cumulative watershed effects as "...the impact on water quality and/or beneficial uses which result from the incremental impact of two (2) or more forest practices. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time." The CWE methodology is designed first to examine conditions in the watershed surrounding a stream, and in the stream itself. It then attempts to identify the causes of any adverse conditions. Finally, it helps identify actions that will correct any identified adverse conditions.

As described in the *Forest Practices Cumulative Watershed Effects Process for Idaho* (Idaho Department of Lands, April 1995), the CWE process consists of seven specific assessments: A) Erosion Hazard, B) Canopy Closure/Stream Temperature, C) Hydrologic, D) Sediment Delivery, E) Channel Stability, F) Nutrients, and G) Beneficial Uses/Fine Sediment. At the request of the Jim Ford Creek WAG, some of the assessments were run on non-FPA land as well. Summaries of the results of each of these assessments in the Jim Ford Creek drainage are presented in Section III.

The CWE "Adverse Conditions Assessment" method was applied to analyze whether significant adverse effects occur in the forested portions of Jim Ford Creek drainage. Adverse condition assessments were conducted for stream temperature, hydrology, and beneficial uses/fine sediment. The adverse condition assessment results are presented in Section IV.

Finally, the CWE process provides guidance to help forest landowners design management practices to alleviate any adverse conditions and prevent problems from future forest practices. These prescriptions and recommendations are presented in Section V.

The following individuals participated in the field data collection:

Jim Mallory (Pottlatch Corporation)
 Mike Goodwin (Pottlatch Corporation)
 Sonny Lage (Pottlatch Corporation)
 Lisa Wertz (Idaho Division of Environmental Quality)
 Johanna Bell Luce (Idaho Division of Environmental Quality)
 Daniel Stewart (Idaho Division of Environmental Quality)
 Jim Clapperton (Idaho Department of Lands)
 Mike Payne (Idaho Department of Lands)
 Mike Hoffman (Idaho Soil Conservation Commission)
 Brian Hoelscher (Idaho Division of Environmental Quality)
 Bob Hassoldt (Private Citizen)
 Ken Heffner (U.S. Forest Service)
 Dave Summers (Idaho Department of Lands)
 Gene Phillips (Idaho Department of Lands)
 Todd Bates (Idaho Department of Lands)
 Bill Love (Idaho Department of Lands)
 Doug Fitting (Idaho Department of Lands)
 Joe Dupont (Idaho Department of Lands)
 Larry Morrison (Idaho Department of Lands)
 Tom Dechert (Idaho Department of Lands)

III. CUMULATIVE WATERSHED EFFECTS ASSESSMENT RESULTS

A. Erosion and Mass Failure Hazard Assessment

The primary landtype associations (LTAs) mapped by the USFS in the drainage are "old volcanic surfaces" (LTA 82), "Tertiary fine sediment surfaces" (LTA 83), "volcanic mountain slopes and ridges" (LTA 64), "volcanic stream breaklands" (LTA 24), and "recent alluvial deposits" (LTA 14). Field work in the drainage compared with the geology and soil maps identified a major section of "old granitic surfaces" (LTA 81) and a smaller area of "old border zone surface" (LTA 85). Figure 2a exhibits the revised LTA map of the watershed. Table 2 presents the CWE hazard rating analysis on a subwatershed basis with overall ratings for surface erosion and mass failure hazards. Figures 2b and 2c show the geographic extent of hazard rating classes for surface erosion and mass failures. The Jim Ford Creek watershed as a whole has a moderate surface erosion hazard rating and a moderate mass failure hazard rating.

Table 2. Jim Ford Creek hazard ratings by subwatershed.

Water-shed No.	Surface Erosion Hazard	Acres per Hazard	Percent	Over-All Rating	Mass Failure Hazard	Acres per Hazard	Percent	Over-All Rating
1401					Low	7622	43	
	Mod	17984	100	Mod	Mod	6289	35	Mod
					High	4002	22	
1402					Low	296	15	
	Mod	1951	100	Mod	Mod	1632	85	Mod
1403	Low	265	4		Low	247	3	
	Mod	7017	96	Mod	Mod	7035	97	Mod
1404					Low	753	11	
	Mod	7151	100	Mod	Mod	6398	89	Mod
1405					Low	884	33	
	Mod	2688	100	Mod	Mod	1804	66	Mod
1406					Low	90	3	
	Mod	2690	100	Mod	Mod	2676	97	Mod
1407	Low	2216	21		Low	3727	35	
	Mod	8021	79	Mod	Mod	6510	65	Mod
1408	Low	4192	57	Low	Low	3486	47	
	Mod	3414	43		Mod	4120	53	Mod
1409	Low	4952	61	Low	Low	4772	58	Low
	Mod	3215	39		Mod	3396	42	
Total	Low	11626	17		Low	21879	33	
	Mod	54119	83	Mod	Mod	39865	59	Mod
					High	4002	7	

B. Canopy Closure/Stream Temperature Assessment

Class I streams and Class II streams contributing at least 20% of the flow were divided into 29 segments at intervals determined by land use and 200-ft elevational change per segment (Figure 3). Percent shading over each segment was estimated from aerial photos and verified with field measurements. Table 3 presents the comparison of the measured results with target shade requirements. The Canopy Closure/Stream Temperature rating is determined only for those segments under forestry land use. Data for the non-FPA segments were collected at the request of the WAG and are presented without a CWE rating. A High rating indicates that there is a high likelihood that vegetative cover is inadequate to maintain stream temperature within the standard.

Table 3. Canopy closure/stream temperature ratings by stream reach.

Stream Segment Number	Existing Canopy Cover (%)	Target Canopy Cover (%)	Chinook Salmon Present (Y or N)	Other Salmon Present (Y or N)	Canopy Closure/ Temperature Rating (H or L)
1	21-40	100	No	Yes	High
2	>90	100	No	Yes	Low
3	71-90	100	No	Yes	High
4	71-90	100	No	Yes	High
5	41-70	100	No	Yes	High
6	21-40	100	No	Yes	High
7	21-40	100	No	Yes	High
8	21-40	100	No	Yes	High
9	41-70	92	No	Yes	High
10	41-70	82	No	Yes	High
11	21-40	FPA min	No	No	Low
12	0-20	Non-FPA	No	No	Non-FPA
13 (Wilson)	0-20	Non-FPA	No	No	Low
14 (Wilson)	21-40	FPA min	No	No	Low
15 (Miles)	21-40	FPA min	No	No	Low
16 (Heywood)	0-20	Non-FPA	No	No	Non-FPA
17 (Unnamed)	0-20	Non-FPA	No	No	Non-FPA
18 (Grasshopper)	0-20	Non-FPA	No	No	Non-FPA
19 (Grasshopper)	21-40	Non-FPA	No	No	Non-FPA
20 (Grasshopper)	41-70	FPA min	No	No	Low
21 (Grasshopper)	21-40	Non-FPA	No	No	Non-FPA
22 (Grasshopper)	21-40	Non-FPA	No	No	Non-FPA
23 (Grasshopper)	41-70	FPA min	No	No	Low
24 (Kamiah Gulch)	0-20	Non-FPA	No	No	Non-FPA
25 (Kamiah Gulch)	41-70	FPA min	No	No	Low
26 (Winter)	>90	82	No	Yes	Low
27 (Winter)	21-40	FPA min	No	No	Low
28 (Shake Meadow)	>90	100	No	Yes	Low
29 (Shake Meadow)	41-70	FPA min	No	No	Low

Comments: Evaluations of all Class I streams in the 5th field HUC. Non-FPA segments were evaluated but no target canopy has been set for these reaches and ratings were not made.

Stream segment no. 1 and nos. 3-9 have High ratings. All of these occur in the lower canyon below the falls (Figure 3).

C. Hydrologic Risk Assessment

Forestry is currently practiced on 52,083 acres, or about 80%, of the Jim Ford Creek watershed. The equivalent area of canopy removed through timber harvest is about 12,976 acres (equivalent acres of canopy removed is the summation of each forested acreage times its percent canopy removed), for an average Canopy Removal Index (CRI) of 0.20 (CRI is the equivalent acres of canopy removed divided by the total acres under forestry).

land use. Figure 5 shows the current land use and canopy condition in the Jim Ford Creek watershed. Table 4 shows the amount of canopy removed for each subwatershed, and the associated CRIs. The Canopy Removal Index is calculated only for those acres that are managed for forestry, i.e., acres used for agriculture/grazing or other land uses are not included in the calculations.

Table 4. Canopy Removal Indices for the Jim Ford Creek subwatersheds

HUC No.	Watershed Name	Total Acres	Equivalent Acres Canopy Removed	Canopy Removal Index
1401	Lower Jim Ford sidewalls	17984	2378	0.13
1402	Shake Meadow	1951	549	0.28
1403	Winter	7282	1864	0.26
1404	Upper Jim Ford sidewalls	7151	846	0.12
1405	Middle Jim Ford sidewalls	2688	613	0.23
1406	Kamiah Gulch	2690	440	0.16
1407	Grasshopper	10586	2329	0.22
1408	Heywood	7337	1190	0.16
1409	Miles/Wilson	8167	2767	0.34

The Canopy Removal Index is coupled with the Channel Stability Index (from Section E below) to produce a hydrologic risk rating (HRR). The HRRs for the six subwatersheds of Jim Ford Creek sampled for Channel Stability are shown in Chart 1 (attached). The HRRs for the Lower Jim Ford Creek sidewalls, Winter Creek, Kamiah Gulch, and Heywood Creek are Low. The HRRs for Grasshopper Creek and Miles/Wilson Creeks are Moderate.

D. Sediment Delivery Assessment

Sediment generated from roads, skid trails, and mass wasting was evaluated for delivery to streams. In order to provide more detailed data for the TMDL process, the road and mass failure data were collected for the Lower Jim Ford Creek sidewalls, Winter, and Grasshopper Creeks on a site-specific basis. Roads were divided into segments with uniform cut slope, fill slope, road surface, road drainage, road type, sediment production, and sediment delivery characteristics such that a CWE "road sediment delivery score" could be calculated for each segment. The intent of this segmentation is to provide a data set with specific road segments for which sediment mass/unit length of road can be calculated or modeled for the TMDL. From these segment scores, a single road sediment delivery score for the subwatershed was calculated using a weighted average based on segment lengths and total length of roads sampled. Similarly for mass failures, each was recorded

for location, volume of material moved, and percent delivery to a waterway. The mass failure sediment delivery score was calculated based on the mass failure frequency, size, and delivery. Much of the data collected in 1998 were recorded using a Geographical Positioning System (GPS) data dictionary and were entered into a Geographical Information System (GIS) for the analysis.

1. Roads

The Jim Ford Creek drainage contains approximately 500 miles of roads (Figure 6 and Table 5). A GIS analysis determined that about 400 miles of the roads are within forestry land use areas, while the other 100 are state, county or city roads, or are in non forestry use areas. Approximately 150-200 miles of the roads were assessed over the different periods of field work, of which about one-fifth were classed by the GIS analysis as non-FPA roads. The road sample was skewed towards roads close to streams and those considered as having high potential to impact water quality.

The CWE road scores for the forested portion of the watersheds range from 19 for the lower Jim Ford sidewalls to 34 for Heywood (Table 5). For the GPS sampled watersheds, road segment score ranges are: 13-75 for Grasshopper, 13-51 for Winter and 13-41 for lower Jim Ford sidewalls. Road scores above 50 are rated High in the CWE process and need attention by land managers. The roads sampled using GPS and the Sediment Delivery ratings for Lower Jim Ford sidewalls, Winter and Grasshopper Creeks are presented in Figure 7.

Table 5. Roads by subwatershed with CWE results for FPA roads.

Watershed Name	All Roads (miles)	FPA Roads (miles)	Non-FPA Roads (miles)	CWE Score FPA Roads	CWE Rating FPA Roads
Lower JF sides	129	96	32	19	Low
Shake Meadow	21	19	2	NS	NS
Winter	62	59	3	25	Low
Upper JF sides	55	33	22	NS	NS
Middle JF sides	20	18	2	NS	NS
Kamlah Gulch	15	12	3	26	Low
Grasshopper	95	67	28	31	Moderate
Heywood	59	47	11	34	Moderate
Miles/Wilson	55	53	2	26	Low
Total	509	404	105	NA	NA

NS = not sampled; NA = not applicable

The Low CWE road sediment ratings reflect some sediment eroding from road surfaces and inside ditches but little delivery to stream channels. The Moderate ratings for Grasshopper and Heywood reflect similar levels of sediment production, and higher delivery due to more roads being close to stream channels.

2. Skid Trails

Most historic harvest activity used ground-based tractor skidding and some of this occurred in stream protection zones. These skid trails have recovered substantially and cannot be used in the future under current FPA rules. New skid trails are outside stream protection zones, resulting in very little delivery of sediment to stream channels. For the Jim Ford Creek watershed, given the erosive nature of the surface soil, "occasional rutting and erosion" was noted in all subwatersheds, resulting in CWE scores ranging from 3-5 (Table 6).

Sediment delivery ratings from skid trails for all the subwatersheds are low.

Table 6. Sediment Delivery Score Summary.

Watershed Name	Sediment Source	CWE Score/Rating	Total Score/Rating
Lower JF sidewalls	Roads	19/Low	
	Skid Trails	4/Low	
	Mass Failures	36/Moderate	59/Low
Winter Creek	Roads	25/Low	
	Skid Trails	4/Low	
	Mass Failures	9/Low	38/Low
Grasshopper Creek	Roads	31/Moderate	
	Skid Trails	4/Low	
	Mass Failures	9/Low	43/Low
Kamiah Gulch	Roads	26/Low	
	Skid Trails	5/Low	
	Mass Failures	9/Low	40/Low
Heywood Creek	Roads	34/Moderate	
	Skid Trails	4/Low	
	Mass Failures	9/Low	47/Low
Wilson/Miles Creeks	Roads	28/Low	
	Skid Trails	3/Low	
	Mass Failures	13/Low	42/Low

Total Sediment Delivery scores <70 receive a Low rating.

3. Mass Wasting

Instances of mass wasting were identified in three of the nine subwatersheds: lower Jim Ford sidewalls, middle Jim Ford sidewalls, and in the Wilson/Miles subwatershed. Table 6 presents the mass failure scores and ratings for the 6 subwatersheds fully assessed. In the Wilson/Miles subwatershed, there are a few, small cut slope and fill slope failures, but they are not delivering sediment to a stream. In the lower Jim Ford Creek sidewalls unit, there are three moderate-sized mass failures with substantial delivery to a stream, resulting in a Moderate mass failure sediment delivery rating. In the Middle Jim Ford Creek sidewalls in the road system to the power plant, there are a number of various sized mass failures with varying amounts of delivery. This unit was not systematically assessed for roads, but note is made that the mass failures and associated sediment delivery are significant management problems in this area.

The mass failure sediment delivery rating is Low for all the watersheds fully assessed, except lower Jim Ford sidewalls, for which the rating is Moderate.

Table 9. CWE Assessment Summary.

Watershed Name	Surface Erosion Hazard	Mass Failure Hazard	Stream Temperature	Hydrologic Risk Rating	Sediment Delivery	BURP/ Fine Sediment
Lower Jim F. sidewalls	Moderate	Moderate	High	Low	Low	Not Full Support
Shake Meadow	Moderate	Moderate	Low	NA	NA	
Winter Creek	Moderate	Moderate	Low	Low	Low	
Upper Jim F. sidewalls	Moderate	Moderate	NA	NA	NA	
Mid Jim F. sidewalls	Moderate	Moderate	NA	NA	NA	
Kamiah Gulch	Moderate	Moderate	Low	Low	Low	
Grasshopper Creek	Low	Moderate	Low	Moderate	Low	Not Full Support
Heywood Creek	Low	Low	Low	Low	Low	
Miles/Wilson Creek	Moderate	Moderate	Low	Moderate	Low	

NA = Not Assessed.

- A. **Beneficial Use/Fine Sediment Adverse Condition** – Wherever the beneficial uses are not fully supported, CWE requires an analysis of the condition. Available BURP calls indicate that the beneficial uses are not being fully supported in Grasshopper Creek, nor the lower reaches of Jim Ford Creek. On the other hand, the CWE sediment delivery rating for both of these watersheds is Low. For such circumstances where the cause of non-support is not evident, CWE calls for further analysis of the situation. Further analysis is being done as part of the TMDL process: other stream segments have been BURPed and support status calls are pending; in-stream sediment data are being analyzed to determine if and where sediment actually is a pollutant in the system; all sediment sources are being identified; and sediment budgets are being developed that will allocate loads derived from forestry vs. other land uses. The conclusion is that the TMDL and its implementation will address the lack of full support of the beneficial uses in Grasshopper and Lower Jim Ford Creek wherever the problem relates to fine sediment.

For the other subwatersheds, in the absence of BURP calls, and in light of Low CWE sediment delivery ratings, management in forested portions should continue to apply standard BMPs and the SSBMPs established through the SSOC agreement to control degradation.

- B. Stream Temperature Adverse Condition – An adverse condition exists for the lower Jim Ford Creek sidewalls subwatershed because of the High Canopy Cover/Stream Temperature ratings for stream segments no. 1 and nos. 3-10. Stream temperature data collected by DEQ and the SCC show that indeed stream temperatures in lower Jim Ford Creek exceed the standard. The stream segments exhibiting the adverse condition extend through several ownerships, primarily Potlatch Corporation, the Idaho Department of Lands, the Nez Perce Tribe, and other private.

The temperature adverse condition appears to be the result of several conditions. Because of the lack of salmonids above the falls, the temperature standard upstream of these lower reaches is 22°C while the standard below the falls is 13°C such that water entering the lower reaches is probably already above the standard for the lower reach. Stream temperature data collected by DEQ and SCC show that stream temperatures above the falls exceed the 22°C standard, let alone the 13°C standard. The lower reach flows through an east-west trending basalt canyon such that during the summer substantial heat builds up resulting in considerable long-wave radiation being emitted from all surfaces which can be absorbed by the water. The stream channel itself is a rather broad, cobble to boulder bed resulting from episodic high flows. During the summer when flows are low, the stream channel is often through the middle of the unshaded and heat absorbing portions of the bed. Stream shading and, therefore, temperature control has been reduced throughout the Jim Ford Creek watershed, certainly in areas converted to agriculture/grazing, and probably in forested areas as well.

The development of CWEMPs to address the adverse stream temperature condition is complicated and difficult under current conditions of the Jim Ford Creek watershed. At the very least, any solution must be related to the question of stream temperature standards for the whole Jim Ford Creek drainage and is being addressed by the WAG as part of the TMDL process. It seems reasonable at this time to wait to develop CWEMPs until all the landowners in the watershed through the WAG have had a chance to address the issue of reconciling these two temperature standards, given the physical setting and pollutants of concern for the watershed as a whole. If the goal is to attain a temperature standard for salmonid spawning in the lower reaches, it is probable that management for this goal will be needed from all land uses in all the subwatersheds upstream of lower Jim Ford Creek.

In the interim until a watershed wide management plan is developed as part of the TMDL, no further shading should be removed from the stream protection zone of the lower reaches of Jim Ford Creek. As soon as an implementation plan for the TMDL has been approved, this adverse condition will be reconsidered under CWE and the FPA to determine whether the implementation plan adequately addresses the condition, and to develop CWEMPs under the auspices of FPA.

- C. Hydrology Adverse Condition – No adverse condition exists.

All of the hydrological risk ratings (HRR) derived from the Canopy Removal Indexes and the Channel Stability Indexes are low or moderate. Since the HRRs are low or moderate, no adverse condition exists. FPA standard BMPs coupled with the SSOC Site-Specific BMPs to control degradation should continue to be implemented. The moderate HRRs for the Grasshopper and Miles/Wilson watersheds indicate that additional thought should be given

to the condition of the stream channel and forest canopy when forest practices are planned and applied.

D. Nutrient Adverse Condition – No adverse condition exists.

No adverse condition exists, since Jim Ford Creek does not contain a lake or major reservoir, and does not flow into a lake or major reservoir.

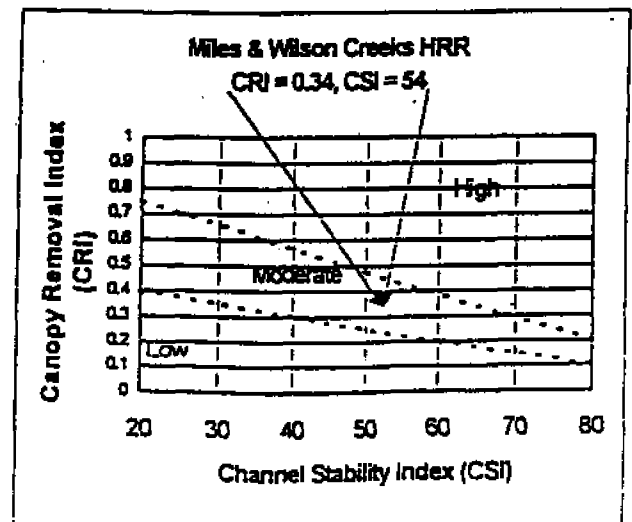
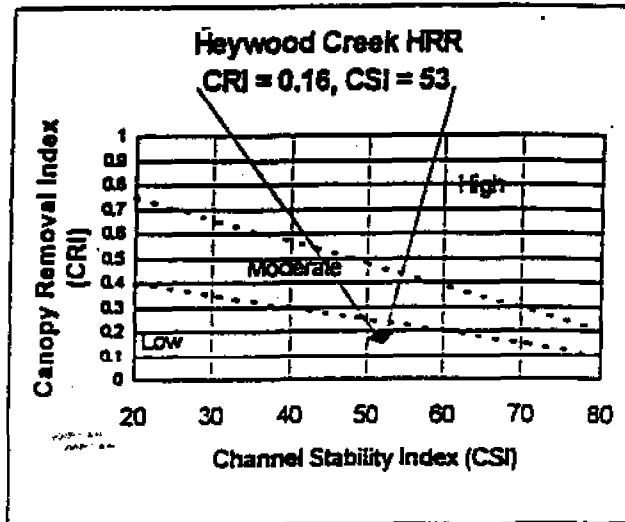
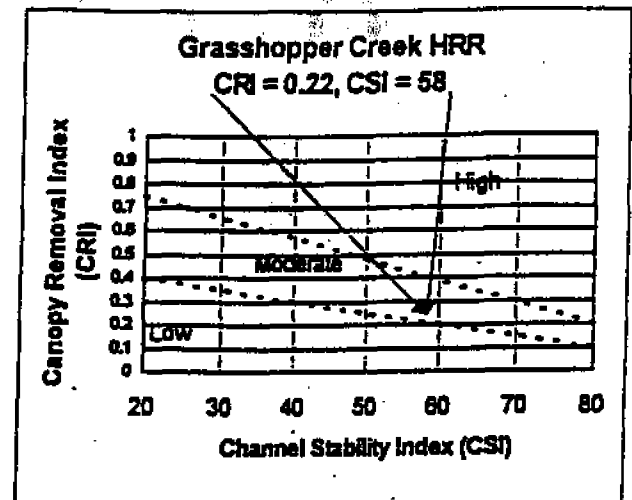
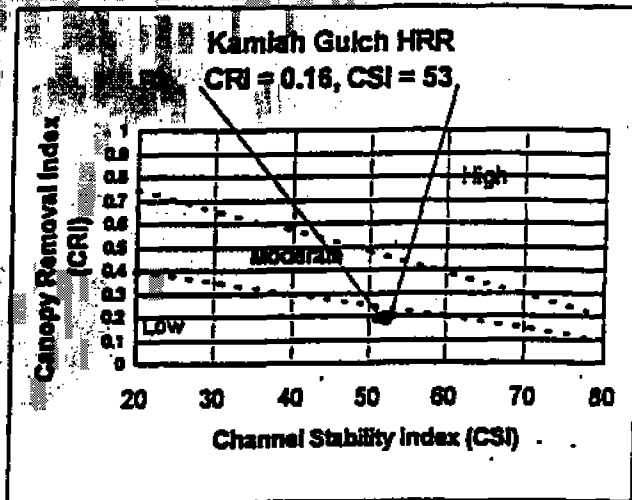
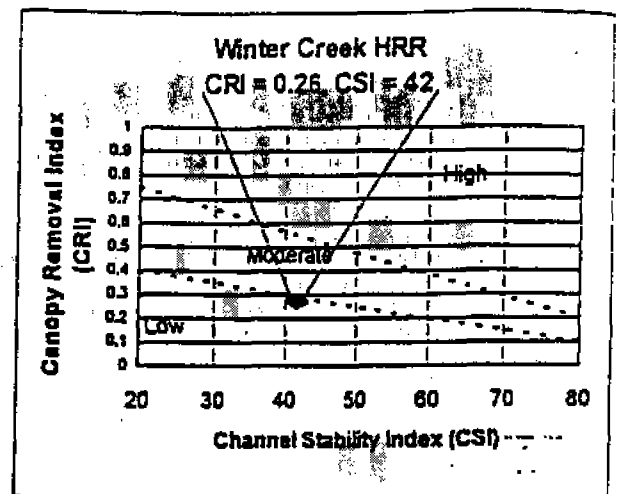
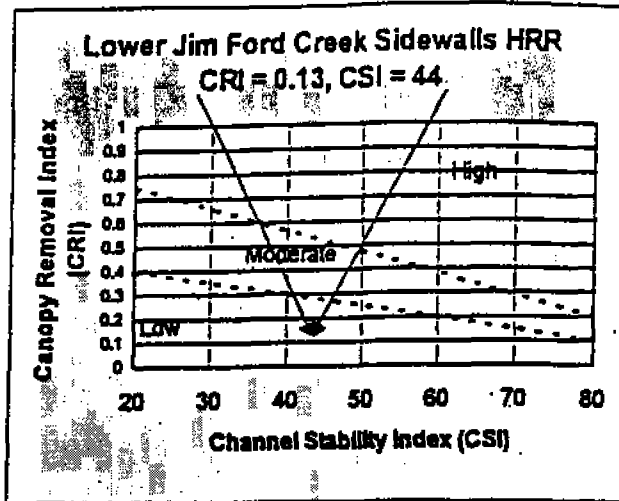
V. MANAGEMENT PRESCRIPTIONS AND RECOMMENDATIONS

An adverse condition for canopy cover/stream temperature was identified in the lower reaches of Jim Ford Creek. An interim strategy of no further shade removal from the SPZ of reaches 1-10 should be enforced until an implementation plan for the TMDL is approved. The various landowners adjacent to the lower reaches should participate in the development of the TMDL and its implementation plan as a part of further analysis of the adverse condition. Upon approval of the TMDL implementation plan, CWEMPs will be developed that will incorporate any pertinent results from the TMDL process and address the adverse condition in a manner adequate to meet the requirements of the FPA.

For all other areas of the Jim Ford Creek watershed, in the absence of any adverse conditions identified for forestry, it is concluded that implementation of standard BMPs of the Idaho Forest Practices Act and modifications from the SSOC Site Specific BMPs under Idaho's antidegradation agreement have protected water quality and beneficial uses in Jim Ford Creek. Further analysis is required by the CWE process for Grasshopper Creek with respect to beneficial uses/fine sediment (BURP) in this subwatershed, but the CWE results indicate that these problems are not related to forest practices.

Since Jim Ford Creek is a Stream Segment of Concern under Idaho's antidegradation agreement, the SSOC Site Specific BMPs should continue to be implemented in the drainage. Even though only one adverse condition was identified for forestry in the watershed, this composite CWE assessment does identify areas of concern for future forestry management. Under the current SSBMPs (Appendix 1), "Preoperational inspections are required on all forest practices." Future pre-operational inspections should consider the following: 1) stream channels in this watershed have a moderate stability risk and 2) both the surface erosion hazard and mass failure hazard ratings are moderate throughout the Jim Ford Creek watershed. Therefore, road design and construction, and canopy management, should pay special attention to minimizing surface water concentration in both space and time.

Chart 1. Hydrologic Risk Ratings (HRR) for sampled subwatersheds of Jim Ford Creek.



C-18

R2E

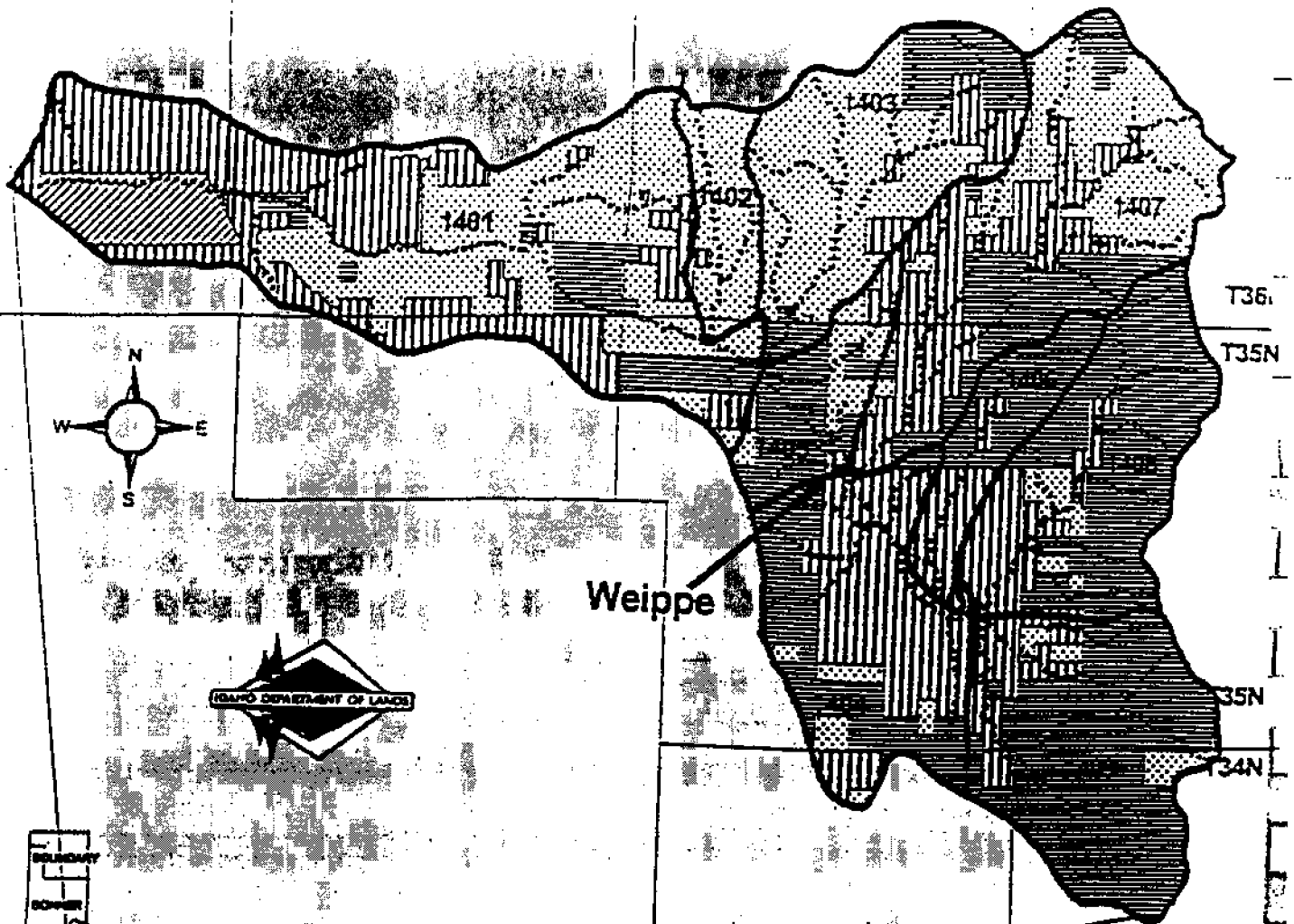
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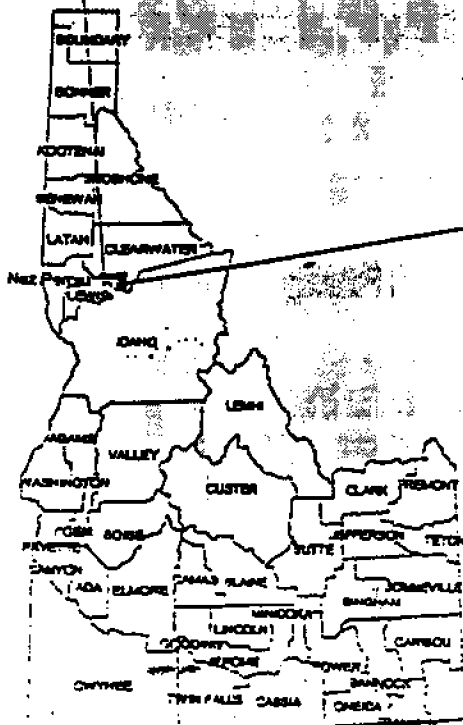
R4E

R4E

R5E



IDAHO DEPARTMENT OF LANDS



Legend



Stream



Township



Watershed Boundary

Ownership



Potlatch Corp.



Idaho Dept. of Lands



USDI BLM



Nez Perce Tribe



Other Private

1 0 1 2 3 4 5 6 Miles

Figure 2a. Jim Ford Creek Watershed Landtype Associations.

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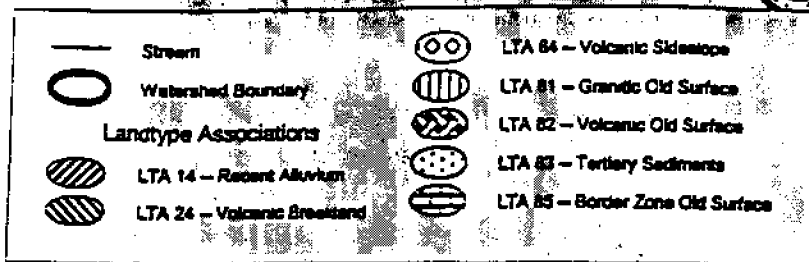


Figure 2b. Surface Erosion Hazards derived from Landtype Associations.

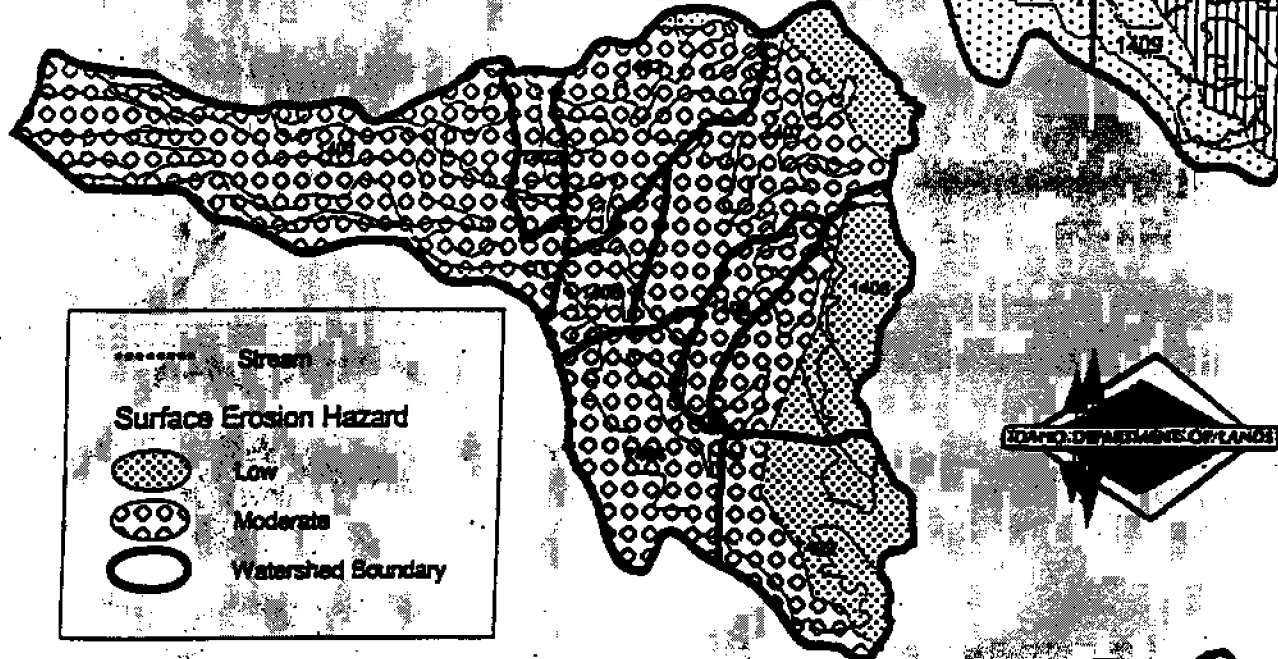
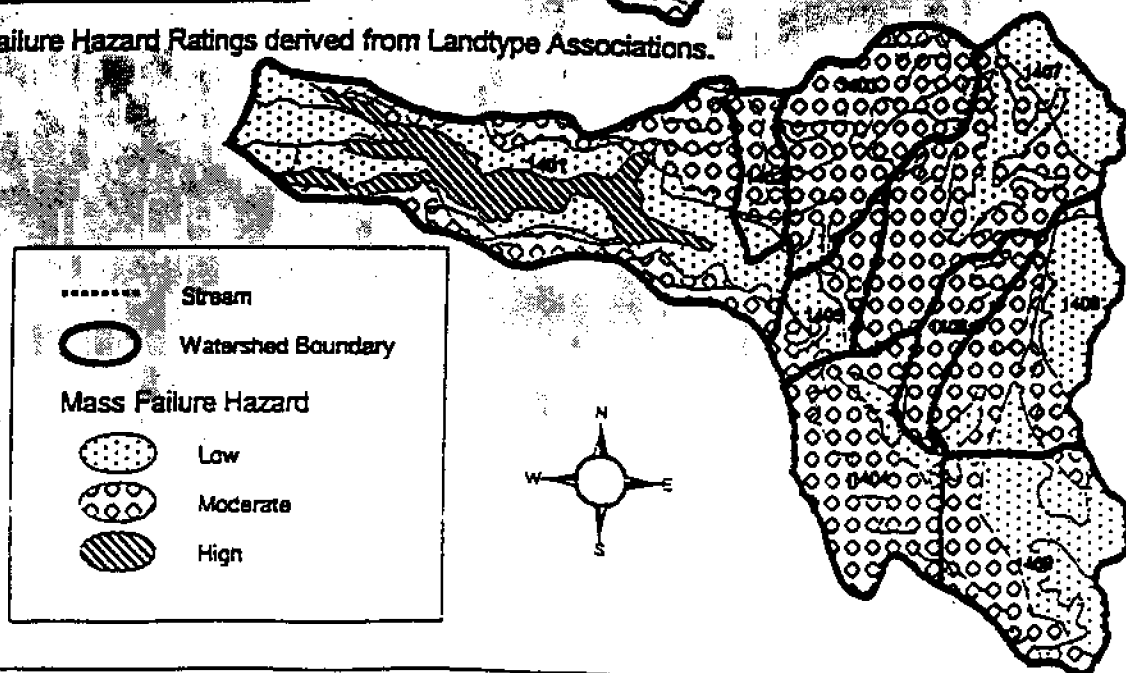


Figure 2c. Mass Failure Hazard Ratings derived from Landtype Associations.



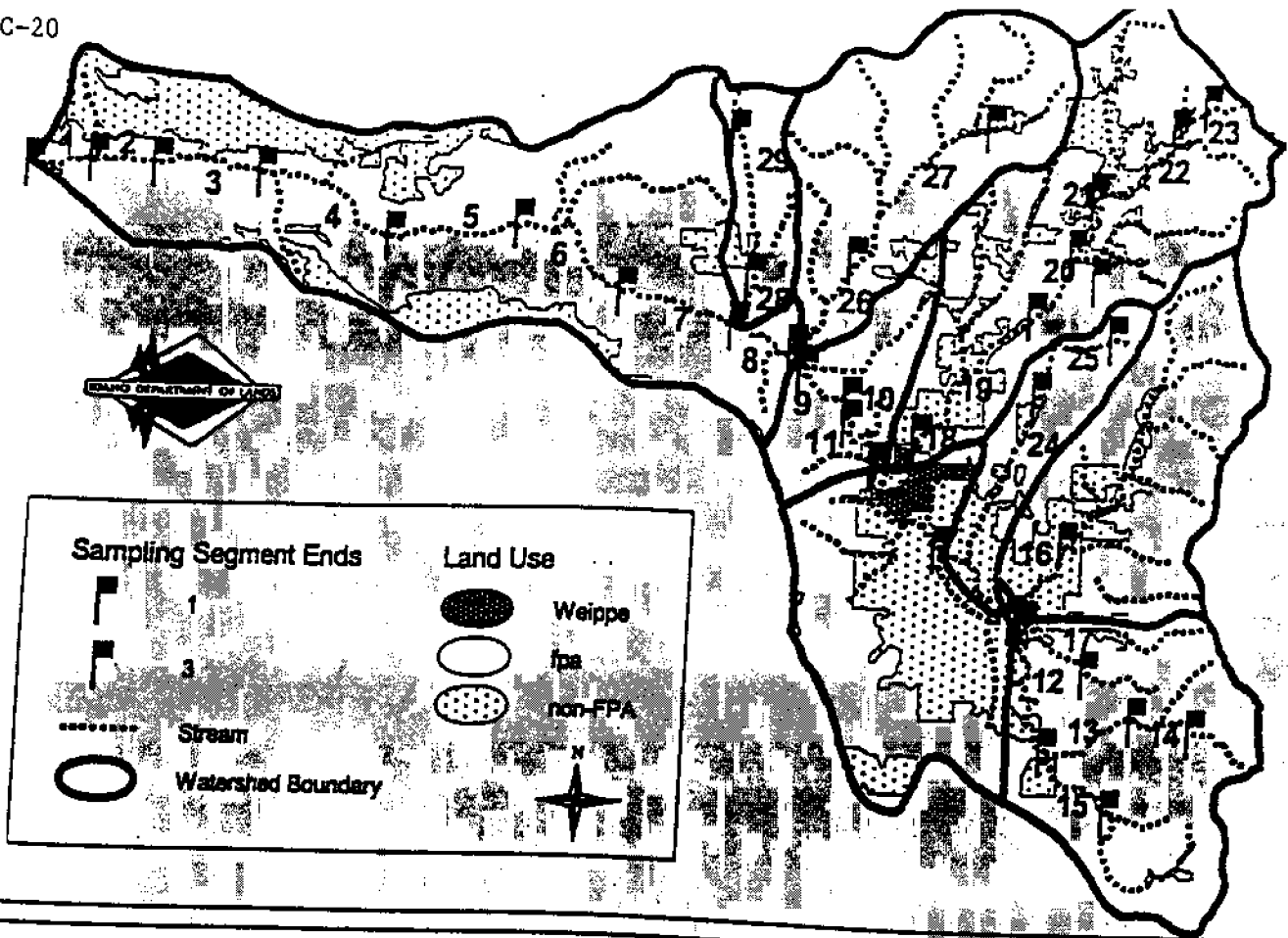


Figure 4. Jim Ford Creek Channel Stability Assessment Reaches.

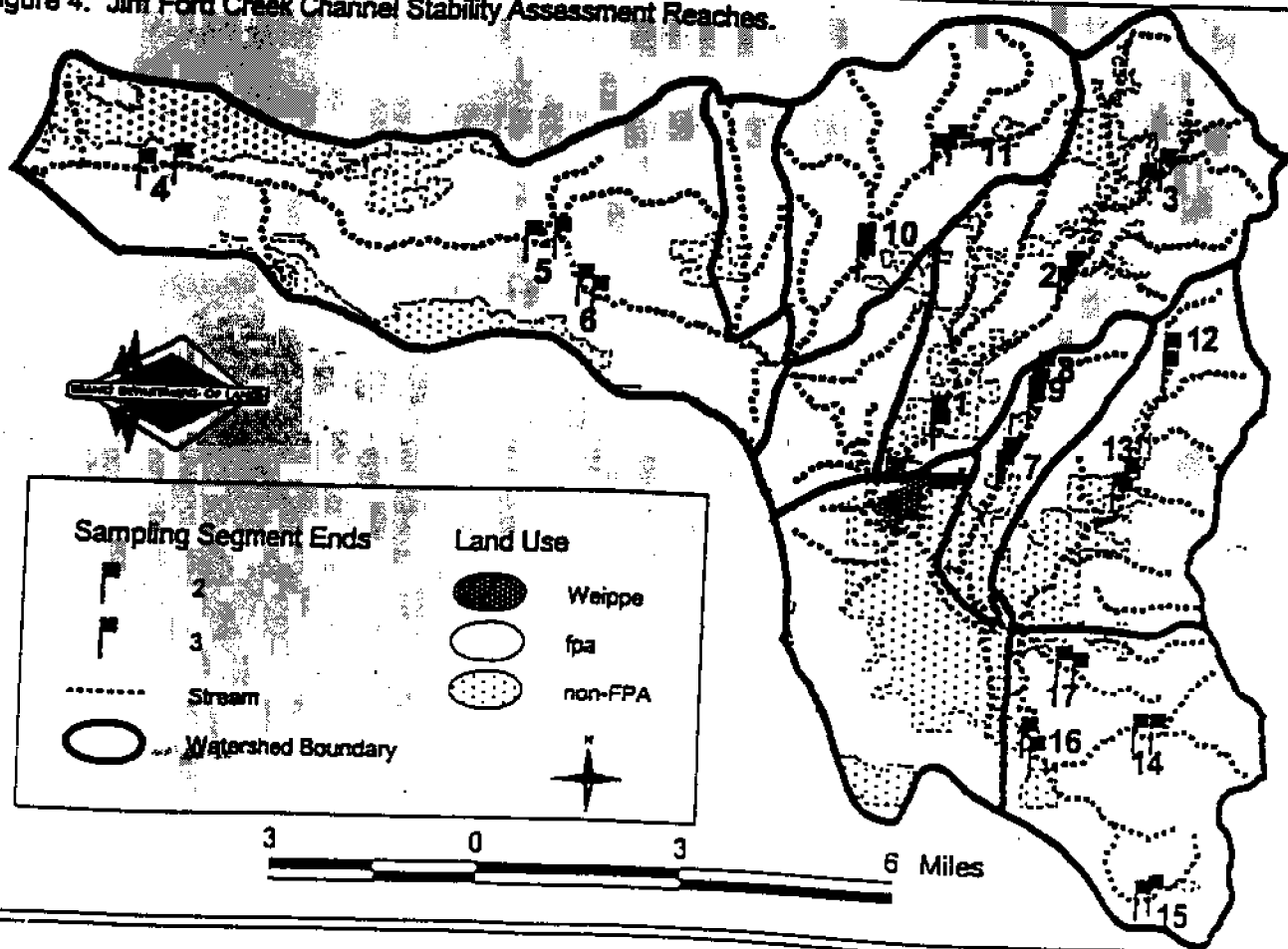


Figure 5. Jim Ford Creek Watershed Forest Canopy and Land Use.

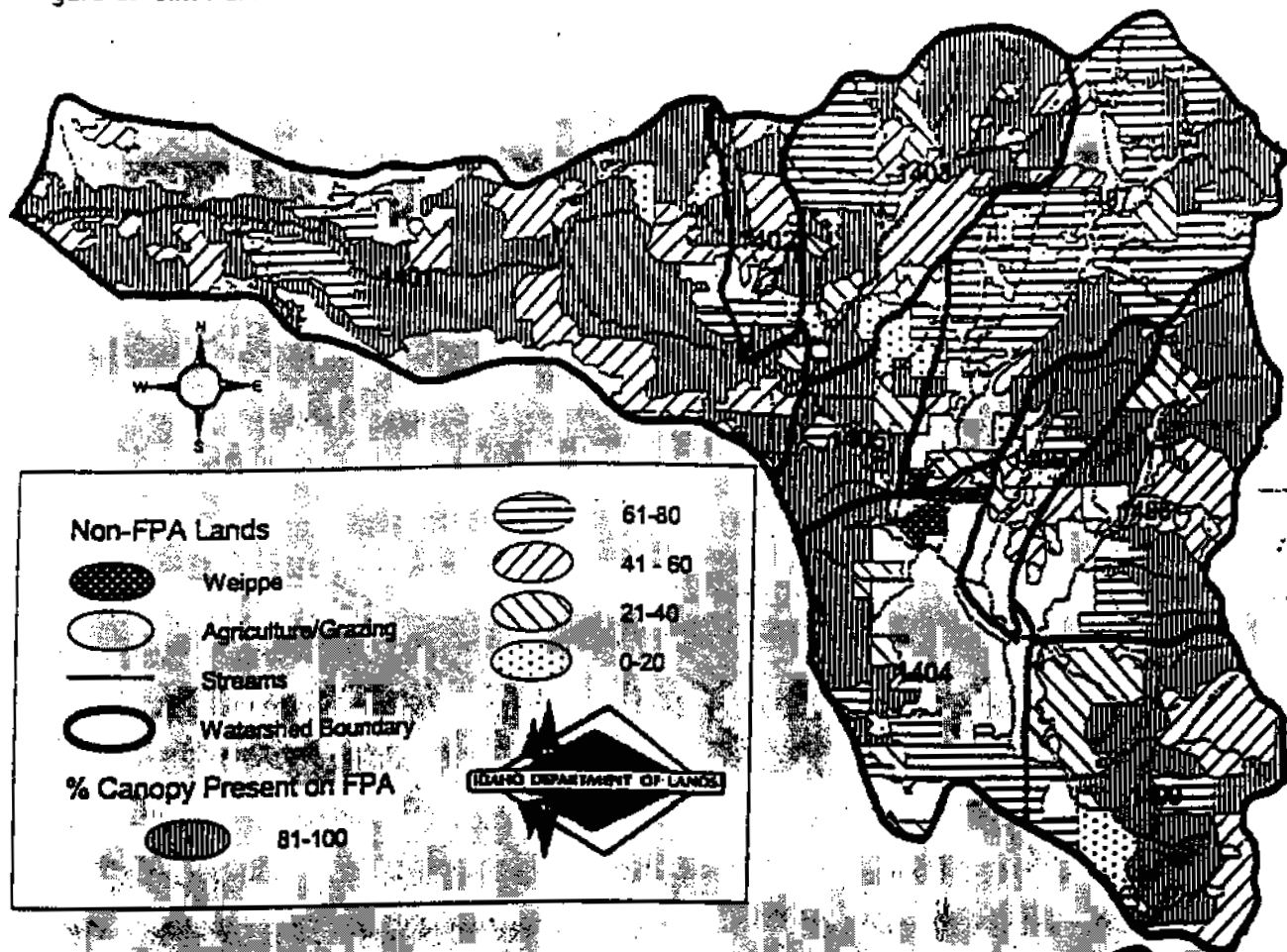
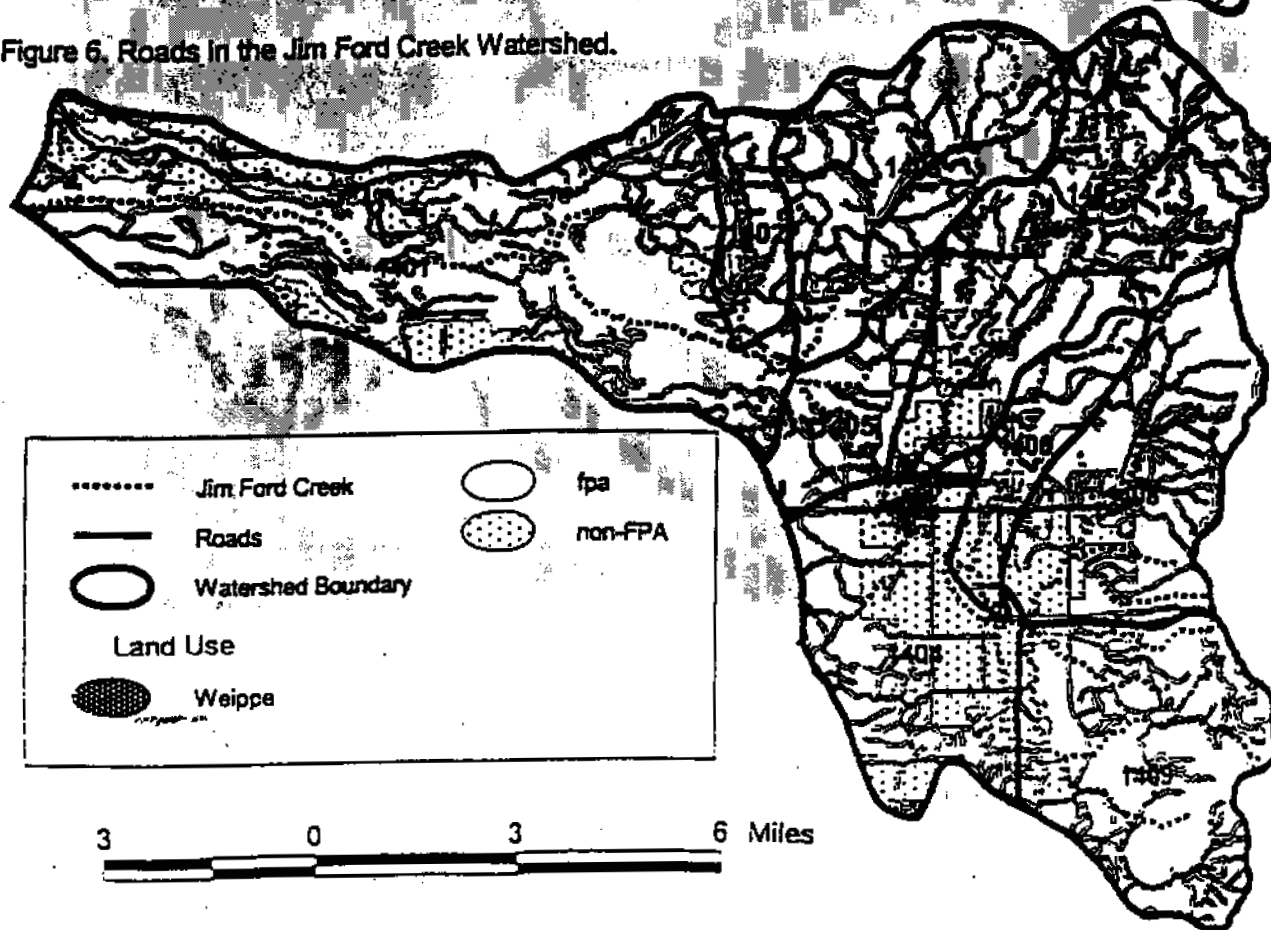


Figure 6. Roads in the Jim Ford Creek Watershed.



C-22

Lower Jim Ford Creek Sidewalls



1 0 1 2 Miles

Winter Creek

Grasshopper Creek



Weippe

- | | |
|--------------------|------------------------|
| Watershed Boundary | Road Sediment Delivery |
| Land Use | |
| Weippe | Not Sampled |
| fpa | Low |
| non-FPA | Moderate |
| | High |

2 1 0 2 4 Miles

FINAL REPORT

FOR

JIM FORD'S CREEK, AGRICULTURE/GRAZING STREAM SEGMENT OF CONCERN

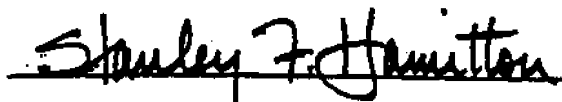
Prepared by:

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and

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Approved by:



Stanley F. Hamilton, Director
Idaho Department of Lands

5-6-91

Date

CHRONOLOGY OF EVENTS

<u>DATE</u>	<u>EVENT</u>
2-16-90	Jim Ford's Creek designated as a stream segment of concern. The primary purpose for designation was agricultural/grazing activity, therefore a local working committee is not required.
Summer '90	Review soil hazard and stream classification maps and past inspection reports in Jim Ford's Creek drainage to determine the need for site specific BMPs.
Fall '90	Field review of Jim Ford's Creek and drainage. Discussion with DEQ regarding possible site specific BMPs. Soil Conservation District received grant to monitor the creek and develop agricultural/grazing BMPs with farming and grazing landowners.
February '91	Development of BMPs with DEQ and Fish and Game input.
April '91	Final report submitted.

SITE SPECIFIC BEST MANAGEMENT PRACTICES

In addition to the Rules and Regulations of the Idaho Forest Practices Act, the following site specific BMPs apply to Jim Ford's Creek, a stream segment of concern. These BMPs were developed in accordance with Rule 8.d. of the Idaho Forest Practices Act Rules and Regulations.

Rule 8.d. Requirements

SITE SPECIFIC BMPs DEVELOPED BY THE FOREST PRACTICES ADVISOR:

GENERAL RULES

1. Preoperational inspections are required on all forest practices.
2. Additional BMPs may be developed as a result of the preoperational inspection and will be specific to that operation.

TIMBER HARVESTING

1. Class II Stream Protection Zone means the area encompassed by a minimum slope distance of 25 feet on each side of the ordinary highwater marks. Hand constructed firelines cannot be within five feet of the ordinary highwater marks.
2. Provide soil stabilization and water filtering effects along streams by leaving undisturbed soils in widths sufficient to prevent washing of sediment into streams. In no case shall this width be less than 25 feet on Class II streams and 75 feet on Class I streams slope distance above the ordinary highwater mark on each side of the stream.
3. Directionally fall timber away from streams and minimize log yarding across or through Stream Protection Zones.
4. Minimize burning in all Stream Protection Zones. The objective is to protect and retain vegetation in the Stream Protection Zone to reduce erosion.

ROAD CONSTRUCTION AND MAINTENANCE

1. Rolling dips or other suitable drainage shall be installed on all newly constructed and reconstructed permanent roads.

OTHER SIGNIFICANT CONCERNS AND ISSUES OF THE ADVISOR

1. Although the SSEMPs will hopefully lessen the impact of logging activity on streams, there remains the problem of unregulated grazing impacts on streams immediately adjacent to logging operations.

Field notes, supporting technical data, and related correspondence are available for review upon request.

APPENDIX D JIM FORD CREEK CHANNEL STABILITY ANALYSIS

Prepared by
Jim Fitzgerald
U.S. EPA, Boise

Abstract

This channel stability inventory sampled about 16% of lower Jim Ford Creek. Channel stability ratings indicate that: 1) the lower gradient channel segments (i.e., $< 1.5\%$) are unstable, transport limited and aggrading as a result of excess coarse bed-material; 2) transport reaches are likely at the threshold of instability; and 3) source reaches are geomorphically stable.

Introduction

The intent of this narrative is to document the *channel stability inventory* (CSI) and analysis of *Jim Ford Creek* (JF). The purpose of this inventory is to help determine if the lower stream channel of JF is stable relative to water and sediment inputs. Results of this analysis are used in combination with aquatic habitat information to determine if bed-material sediments are adversely impacting the coldwater biota and salmonid spawning beneficial uses of JF.

Channel stability is defined as follows: the relationship of sediment supply and stream energy available in a channel system. As changes occur in either supply or energy, the channel stability is affected and the channel tends to adjust its boundaries to accommodate the change (i.e. when the supply exceeds the carrying capacity (aggradation occurs) or the energy exceeds supply (degradation occurs)) (U.S. EPA 1980). The *channel stability rating* (CSR) is a numerical rating of channel stability using Pfankuch's (1975) procedures which account for hydraulic forces, resistance of channel to flow forces, and the capacity of the stream to adjust and recover from changes in flow and/or sediment load (U.S. EPA 1980).

The CSI attempted to sample each valley and channel type of lower JF. Using the Montgomery and Buffington (1993) terminology, the three dominant valley types are confined bedrock valleys, alluvial confined, and alluvial unconfined. The average sidewall slope is about 30% and ranges from 10 to 60%. The 3 dominant channel types are step-pool, pool-riffle, and braided. The average stream gradient is about 2%, and the average d_{50} particle size is 132 mm.

Results

Three kinds of data are collected at each inventoried reach. First, the CSI which ocularly measures features of the upper bank, lower bank, and channel bottom. Second, at the bottom and top of each inventoried segment photo points are photographed, and channel bankfull width, depth at three verticals, and slope are measured. In addition, ocular estimates of particle size distribution of the d_{16} , d_{50} , and d_{84} are made. Pebble counts are taken at about 70% of the

segments to check the ocular estimates of particle size distribution. Third, a rapid evaluation of sediment sources (e.g. mass wasting features), storage (e.g. depositional features), and transport (e.g. bridge scour) is conducted. For the raw data refer to Plates 1, 2, and 3.

Segment and Reach Sampling Scheme:

The lower reach of JF is targeted for the CSI survey because it is critical for steelhead and salmon spawning and rearing. A natural fish barrier is located about 14 miles upstream from the mouth of JF.

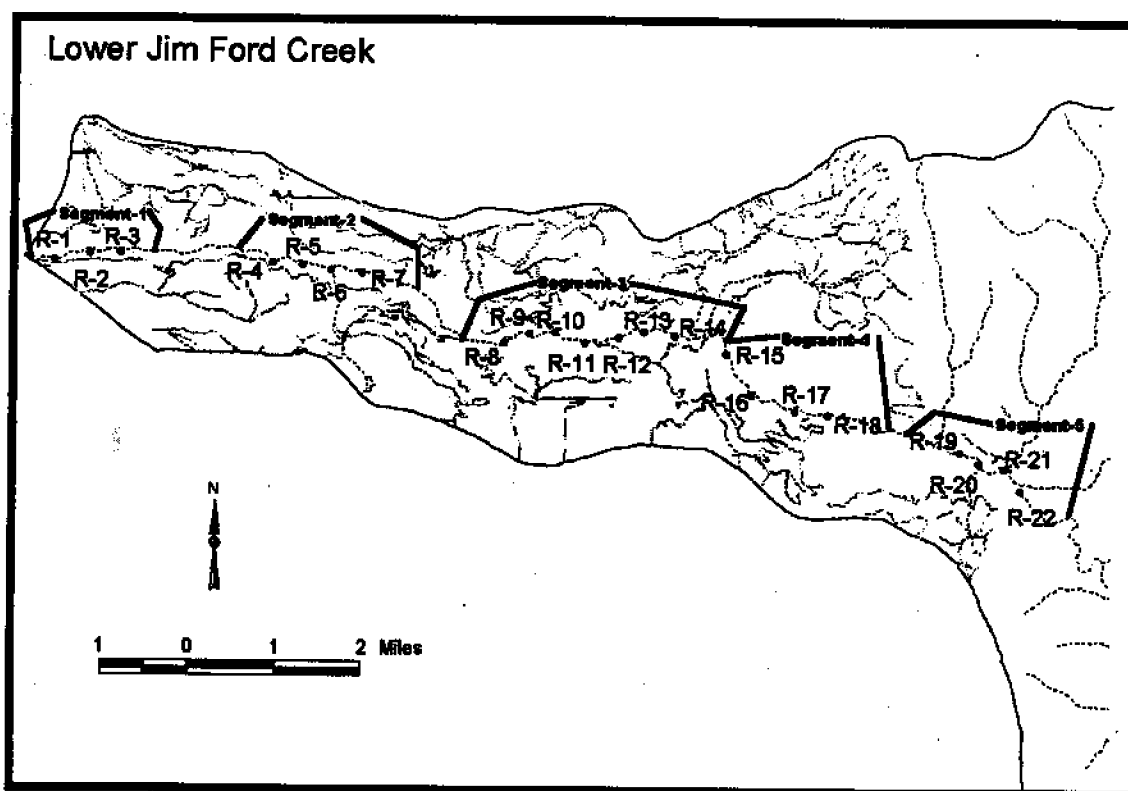


Figure D-1. Channel Stability Inventory Segment Location Map

These features serve as the upper and lower boundaries of the CSI, respectively (Figure D-1). CSIs are completed at systematic intervals along lower JF. Geographic Information System (GIS) and Global Positioning System (GPS) data are used to quantify reach and CSI segment lengths.

Stream segments are about 2000 feet long of which about 500 feet is sampled. Because pace counts are used to measure stream distance in the field the actual length of each segment varies. To quantify the actual distances more accurately and precisely a GPS position was taken at the bottom and top of each reach (Figure D-1).

Of the 14.6 mile reach the survey crews walked about 50% and inventoried 16%. Segment lengths range from about 1 to 2 miles, and, on average, 33% of each segment was inventoried (Table D-1).

Channel Stability Inventory Results

The CSI produces categorical data which are listed in Plates 1a and 1b. These data are analyzed using two approaches, 1) gross CSRs, and 2) gross CSRs sorted by slope class.

Using the original Pfankuch (1975) method this analysis found that of the 22 sampled segments: 1) 0% are in the excellent; 2) 38% are in the good; 3) 33% are in the fair; and 4) 29% are in the poor categories.

The gross CSRs are sorted by slope class to better understand the stability of critical reaches of lower JF (Myers and Swanson 1992). Three slope classes are used for this analysis according to Montgomery and Buffington (1993): 1) source ($> 3\%$ slope); 2) transport (1.5 to 3% slope); and response ($< 1.5\%$ slope). Of the 22 inventoried segments: 1) 27% are source; 2) 50% are transport; and 3) 23% are response channels. Channel slopes measured independently from topographic maps and aerial photos show that of the lower 14 miles of JF: 1) 23% are source; 2) 50% are transport; and 3) 27% are response channels. Proportionally, the CSI evenly sampled the different slope classes.

Sorting the gross CSRs by slope class shows that about 70% of the source reaches are in the good category with no reaches in the poor category. The majority of the transport reaches are in the good to fair categories with 22% in the poor category. None of the response reaches are in the good category and 67% are in the poor category (Table D-2).

Table D-1. CSI Segment Length Information and percentage of Lower Jim Ford Creek Inventoried (see Figure D-1 for location of each reach)

Total Reach Length (mi)			14.6	
Percent walked by crews			49	
Percent Sampled			16	
Segment Code	Length (mi)	Reach Code	Length (mi)	% Segment Sampled
S-1	0.87	R-1	0.15	41
		R-2	0.11	
		R-3	0.10	
S-2	1.26	R-4	0.11	34
		R-5	0.10	
		R-6	0.10	
		R-7	0.12	
S-3	2.37	R-8	0.08	31
		R-9	0.10	
		R-10	0.11	
		R-11	0.11	
		R-12	0.11	
		R-13	0.10	
		R-14	0.12	
S-4	1.66	R-15	0.12	26
		R-16	0.10	
		R-17	0.10	
		R-18	0.10	
S-5	1.04	R-19	0.10	40
		R-20	0.10	
		R-21	0.10	
		R-22	0.11	
Total (mi)	7.20		2.36	33

Table D-2. Results of Gross CSR Sorted by Slope Class

Slope Class	Stability Rating	Freq	% of Total
Response	poor	3	67
	fair	2	33
	good	0	0
	excel	0	0
Transport	poor	3	22
	fair	3	33
	good	5	44
	excel	0	0
Source	poor	0	0
	fair	2	29
	good	4	71
	excel	0	0

Channel Geometry and Particle Size Results

At the top and bottom of each inventoried segment channel and substrate measurements are taken: 1) bankfull width; 2) bankfull depth at 3 verticals; 3) channel slope; and 4) ocular estimates of the d_{16} , d_{50} , and d_{84} particle sizes. These measurements are used to classify the various channel types. Random pebble counts are taken to check the accuracy of ocular estimates of particle size distribution.

The bankfull width and depth measurements are used to calculate the width to depth ratio (W/D). The W/D ratio is calculated using the maximum bankfull depth (thalweg) and the average bankfull depth. The average bankfull depth is calculated by averaging left and right edge (i.e. 0) and the three depth measurements. For the results refer to Plate 2.

The summary statistics of lower JF W/D (average depth) and slope are listed in Table D-3. There is a wide range of W/D ratios with an average of 57, a minimum of 13, and a maximum of 233. An average channel slope of 2% was measured and ranged from 0.5 to 5%.

These data are also sorted by channel type. The statistics are presented to show the variability of a given parameter by channel type. For example, the d_{50} of the substrate tends to increase from response to source reaches (Table D- 3).

Table D-3. Summary Statistics for Channel Geometry and Particle Size Data Sorted by Slope Class

Slope Class	low	medium	high
mean W/D	103	46	39
standard deviation W/D	106	35	27
mean slope	1.5	2.2	3.5
standard deviation slope	1.4	2.0	4.0
mean d_{50}	69	118	357
standard deviation d_{50}	64	128	180

The bed-material particle size data of lower JF are normally distributed. These data show that the bed-material of this reach is dominantly cobble size material and contains very little of the sand to gravel sizes. The majority of the bed-material is basalt, well rounded, and moderately sorted. Some of the bed-material tends to be sub-angular and poorly sorted in the vicinity of recent mass failures. The average d_{50} for all the CSI segments is 132 mm (large cobble). Response reaches have an average d_{50} of 69 mm, transport reaches an average of d_{50} of 118 mm, and source reaches have an average d_{50} of 357 mm.

The pebble counts are made to check the accuracy of ocular particle class estimates. For the d_{50} particle size the observations are, on average, within 16% of the measured value. The greatest error occurs for the d_{25} particle size (> 100%). Because of the low standard error for the d_{50} particle class (< 20%), the ocular data are reliable.

Sediment Sources

The sediment source inventory maps and measures sources and deposits of bed-material. The basic characteristics of mass wasting features are mapped and include: 1) GPS and map location; 2) type of source material; 3) basic geometry; 4) percent delivery; and 5) possible triggering mechanisms. Discrete sediment deposits are measured to estimate instream sediment volume stored, and indicators of lateral and vertical scour are measured to estimate scour rates.

During the CSI, 12 mass wasting features were identified. They are all debris flows and/or torrents and all occurred on slopes greater than 40%. They typically deliver the majority of their debris to the stream channel. Debris flows occur in metamorphic and basalt lithologies, however, field mapping of failure deposits indicates that the metamorphic rocks are more susceptible than basalt rocks to mass failure. The triggering mechanism for most of the failures

was not evident in the field. Of the 12 features, it is clear that roads caused 4 features to fail.

Volume estimates of discrete sediment deposits are made at 3 sites. The first was a typical gravel bar which has a volume of about 64 yd³. The bed-material is well rounded and has a d_{50} of about 64 mm. The second site is near a debris flow deposit which has a volume of about 4,200 yd³. The material is angular and has a d_{50} of about 180 mm. The third site was also near a debris slide deposit which has a volume of about 2,000 yd³. The material is angular to sub-angular and has a d_{50} of about 120 mm. Not all of the deposited material measured is a result of the debris flows, and is likely a combination of instream gravels and debris deposits. Observations suggest, however, that in low gradient areas adjacent to debris flows more coarse material is stored than in areas with no debris flows. In addition, the material near debris flows is more angular, in other words, it has not been transported far from the up slope source.

Estimates of long-term scour rates are attempted, however, only 3 reliable indicators are identified. At site R-18, a birch tree greater than 100 years old is presently being undercut by the stream (NPT 1999). About 15 feet of lateral scour was measured indicating that about 0.15 feet of bank is lost per year. At site R-12, two old growth cedar trees are presently being undercut by the stream. About 5 to 6 feet of scour was measured on both the left and right bank indicating that the stream is widening along this reach. Above site R-14, the Green Road Bridge is an indicator of vertical scour rates. The bottom of the bridge abutments, which approximate where the stream bed was originally, are exposed as a result of channel incision. Worth note, this scour is not localized to the bridge extending up and downstream about 500 feet. At the bridge there has been about 5 feet of vertical scour over the last 12 to 15 years or 0.4 to 0.3 feet per year (Hoffman 1999). It is likely that this scour resulted from a few extreme flood events rather than on an average annual basis.

Discussion

This analysis uses accepted methods to evaluate channel stability and a weight of evidence approach to determine if lower JF is in a stable state or in dynamic equilibrium (Pfankuch 1975; Montgomery and Buffington 1993; Myers and Swanson 1992). The CSR data suggest that the lower gradient reaches are unstable as a result of excess bed-material between 64 and 256 mm. These data also suggest that the transport reaches are at the threshold of geomorphic stability. Channel instability tends to occur in alluvial unconfined valleys, channels within alluvial confined valleys tend to be in a semi-stable state, and channels within bedrock valleys are in a stable state.

Response reaches account for about 23% of lower JF or about 3 miles. The CSR indicate that these reaches are unstable (i.e. poor category). According to the data, the instability occurs mainly in the channel bottom as a result of deposition except where mass failures are present (Plates 1b). Substantial aggradation is occurring in these reaches causing the channel type to change from a meandering to a braided stream. These response reaches have an average W/D ratio of 103 feet meaning these reaches are also very wide and shallow. These observations are

common channel responses to increased coarse sediment load (Madej 1999; Montgomery and Buffington 1993; Rosgen 1996).

Half of the lower JF stream channel is a transport reach. About 55% of the CSI segments fall into the fair to poor categories. For the unstable segments the main problems appear along the lower bank and channel bottom. These segments tend to be scoured in the higher gradient sections (i.e. 2-3% slope), and aggraded in the lower gradient sections (i.e. 1.5-2% slope): for example, at natural bedrock channel constrictions, the pools tend to be partially filled with cobble size bed-material. Whereas, for higher gradient channels, the bankfull flow appears to be scouring the lower banks, and the bankfull width appears to be increasing: for example, old growth cedar trees which have been growing on a stable terrace for at least the last 100 years are now being undercut by the stream channel (NPT 1999). This might indicate that the state of transport reaches is shifting as a result of increased sediment and/or water inputs.

Source reaches make up about 27% of lower JF. According to the data, these reaches are geomorphically stable. Channel stability likely results from the fact that these channels tend to be high gradient and the bed-material is dominantly boulder to bedrock which provide a relatively stable channel configuration. Water and sediment are rapidly transported through these reaches and delivered to the lower gradient reaches where the sediment then is deposited.

References

- Hoffman, Mike. 1999. Personal oral communication between Mike Hoffman of the ISCC Orofino Office and Jim Fitzgerald of the U.S. EPA Boise Office.
- Montgomery, D. R. and J. M. Buffington. 1993. Channel classification, prediction of channel response, and assessment of channel condition. Report TFW-SH10-93-002.
- Myers, T.J. and S. Swanson. 1992. Variation of stream stability with stream type and livestock bank damage in northern Nevada. *Water Resources Bulletin*, V. 28 (4), p. 743-754.
- Nez Perce Tribe. 1999. Personal oral communication with John Degroot of the NPT Land Services Department regarding the approximate age of trees based on the base width and Jim Fitzgerald of U.S. EPA Boise Office..
- Pfankuch, D. J. 1975. Stream reach inventory and channel stability evaluation. USDA, Forest Service, R-1-75-002. Government Printing Office #696-260/200, Washington D.C.
- Rosgen, D. L. 1996. Applied river morphology. Wildland Hydrology, Pagosa Springs, CO.
- [U.S. EPA] United States Environmental Protection Agency. 1980. An Approach to Water Resources Evaluation of Non-Point Silvicultural Sources (A Procedural Handbook). Environmental Research Laboratory, Athens, GA. EPA-600/8-80- 012.

Plate 1a. Channel stability rating data, unsorted.

Reach Code	Stream Mile	Excell	Good	Fair	Poor	Total	Stability Rating
1	0.5	0	57	16	2		good
2	0.9	0	20	70	17		poor
3	1.3	5	51	20	0		good
4	3.2	24	24	5	0		good
5	3.5	21	29	3	0		good
6	3.9	19	37	3	0		good
7	4.3	6	34	37	0		fair
8	6.4	0	6	94	20		poor
9	6.7	1	28	69	4		fair
10	7.1	0	27	82	8		poor
11	7.5	0	24	73	4		poor
12	7.9	1	53	28	0		fair
13	8.3	2	44	30	12		fair
14	8.6	0	4	27	108		poor
15	11.2	0	6	72	44		poor
16	9.6	0	10	75	22		poor
17	10.0	0	12	54	78		poor
18	10.7	2	20	78	8		poor
19	13.1	4	55	13	0		good
20	13.4	5	58	12	0		good
21	13.7	4	59	12	0		good
22	14.0	14	44	2	0		good

Plate 1b. Channel stability rating data, sorted by slope class.

Reach Code	Stream Mile	Slope Class	Excell	Good	Fair	Poor	Total	Stability Rating
1	0.5	transport	0	57	16	2	75	good
2	0.9	transport	0	20	70	17	107	poor
3	1.3	transport	5	51	20	0	76	good
6	3.9	transport	19	37	3	0	59	good
7	4.3	transport	6	34	37	0	77	fair
8	6.4	transport	0	6	94	20	120	poor
9	6.7	transport	1	28	69	4	102	fair
10	7.1	transport	0	27	82	8	117	poor
18	10.7	transport	2	20	78	8	108	fair
20	13.4	transport	5	56	12	0	73	good
22	14.0	transport	14	44	2	0	60	good
								good
								good
								fair
								fair
								poor
								poor
11	7.5	response	0	24	73	4	101	fair
14	8.6	response	0	4	27	108	139	poor
16	9.6	response	0	10	75	22	107	fair
17	10.0	response	0	12	54	78	144	poor
15	11.2	response	0	6	72	44	122	poor

Plate 2. Channel geometry and grain size data.

Reach	Reach Code	Stream Mile (mi)	Reach Length (mi)	BFW (ft)	BFD (ft)	BFD (ft)	BFD (ft)	BFD (ft)	BFD (ft)	Slope (%)	d16 (mm)	d50 (mm)	d84 (mm)	mean W/D (ft)	max W/D (ft)	Slope Class
C-1	1	0.5	0.15	44	0	1.3	0.8	1.2	0	2.0	45	128	>300	66.7	33.8	transport
	1	0.6		58	0	1.6	1.7	1.8	0	2.0	45	90	>300	56.9	32.2	transport
C-2	2	0.9	0.11	25	0	2.3	2	3.2	0	2.5	45	128	>300	16.7	7.81	transport
	2	1.0		43	0	1.8	1.4	1.8	0	2.3	32	90	<300	43	23.9	transport
C-3	3	1.3	0.10	32	0	1.9	2	1.5	0	1.8	32	90	>300	29.8	16	transport
	3	1.4		44	0	2.9	2.7	1.9	0	2.0	16	128	>300	29.3	15.2	transport
B-5	4	3.2	0.11	47	0	1.7	1.4	1.5	0	4.0	45	180	<300	51.1	27.6	source
	4	3.3		42	0	3	3.1	2.5	0	4.0	45	300	>300	24.4	13.5	source
B-6	5	3.5	0.10	21	0	2.4	3.6	1.9	0	5.0	90	180	300	13.3	5.83	source
	5	3.6		74	0	2.6	0.3	0.5	0	4.0	45	90	180	109	28.5	source
B-7	6	3.9	0.12	38.5	0	2.1	1.6	1.3	0	2.0	64	128	<300	38.5	18.3	transport
	6	4.0		36	0	2.6	1.1	1.9	0	2.0	45	90	<300	32.1	13.8	transport
B-8	7	4.3	0.12	58	0	1.7	1.5	0.6	0	2.3	64	128	>300	76.3	34.1	transport
	7	4.4		81	0	1.3	0.7	1	0	1.0	64	128	<300	135	82.3	transport
A-5	8	6.4	0.08	36	0	1.9	2.3	1.8	0	2.5	16	45	90	30	15.7	transport
	8	6.5		53	0	0.6	1.7	1.1	0	3.8	22.6	64	180	77.9	31.2	transport
A-6	9	6.7	0.10	35	0	1.9	1.8	1.5	0	1.5	32	90	128	33.7	18.4	transport
	9	6.8		37	0	2	1.7	2.3	0	2.5	32	90	180	30.8	16.1	transport
A-7	10	7.1	0.11	36	0	1.9	2.3	1.8	0	2.0	32	90	300	30	15.7	transport
	10	7.2		54	0	2.1	1.4	1.6	0	1.5	32	90	300	52.9	25.7	transport
A-8	11	7.5	0.11	42	0	0.9	1.1	1.4	0	1.5	32	64	128	61.8	30	response
	11	7.6		53	0	0.3	1.7	1.5	0	1.0	32	64	90	75.7	31.2	response
A-9	12	7.9	0.11	38	0	1.1	1.3	1	0	3.5	32	300	2000	55.9	29.2	source
	12	8.0		37	0	1.2	1.7	1.3	0	2.5	22.6	90	100	44	21.8	source
A-10	13	8.3	0.10	65	0	1	5.5	2	0	5.5	32	2000	10000	38.2	11.8	source
A-11	14	8.6	0.12	55	0	1	2.5	0.5	0	1.0	16	45	128	68.8	22	response
	14	8.8		70	0	1	0.5	0	0	1.0	16	45	300	233	70	response
A-4	15	11.2	0.10	51	0	0.3	1.5	0.1	0	1.5	22.6	64	180	134	34	response
	15	11.3		38	0	1.6	2.3	1.7	0	1.5	11	64	90	33.9	16.5	response
A-1	16	9.6	0.12	62	0	1.7	2.4	1.5	0	1.5	32	64	90	55.4	25.8	response
	16	9.7		78	0	0.6	1.2	0.8	0	1.8	22	64	90	150	65	response
A-2	17	10.0	0.10	112	0	3.2	2.3	0	0	0.8	32	128	180	102	35	response
	17	10.1		144	0	1	3.7	1.8	0	1.3	32	90	128	111	38.9	response
A-3	18	10.7	0.10	48	0	2.7	1.6	1.3	0	2.5	64	128	180	42.9	17.8	transport
	18	10.8		54	0	0.7	1.3	2.5	0	2.5	64	128	180	60	21.6	transport
B-1	19	13.1	0.10	27	0	3.4	2	1.6	0	5.0	45	180	300	19.3	7.94	source
	19	13.2		29	0	2.9	2.6	1.8	0	2.0	45	180	300	19.9	10	source
B-2	20	13.4	0.10	39	0	2.1	1.8	1.7	0	2.0	45	128	256	34.8	18.6	transport
	20	13.5		30	0	1.8	1.7	1.5	0	2.0	32	128	180	30	16.7	transport
B-3	21	13.7	0.10	37	0	2.5	2	2.5	0	5.0	90	300	>300	26.4	14.8	source
	21	13.8		35	0	2.7	1.9	2	0	2.0	45	128	>300	26.5	13	source
B-4	22	14.0	0.11	26	0	2.4	1.7	2.4	0	3.0	90	300	>300	20	10.8	transport
	22	14.1		39	0	3	1.1	1.5	0	3.0	64	180	>300	34.8	13	transport

Plate 3. Sediment source inventory data.

Sediment volume estimates

Feature	Reach Code	Height (ft)	Length (ft)	Width 0.16	Width 0.5	Width 0.84	mean Width (ft)	dBH	MS girth	Estimated Volume (yd3)	Estimated Volume (yd3)	Notes
S1	15	2	80	38	27	12	25	64	1000	1723	64	material trapped behind a log jam
S2	14	3	550	44	138	232	138	64	1000	113850	4217	material from a recent debris torrent (feature-2)
S3	8	5	360	30	90	65	62	0	0	53958	1998	material from a recent debris torrent, angular material

Masswasting estimates (12 features total seen during inventory)

Feature	Reach Code	GPS File	slope	width	length	delivery (%)	source material	triggering mechanism(s)	Notes
1	15	072100	50	25	300	100	mm rx	unknown	Cannot see crown from creek goes upslope at least 300'. Large angular boulders at toe and instream. 15' outbanks
2	14	072115	50	65	690	100	mm rx	road failure	Steep slide which obviously originates from road at least three other features along this reach from road
3	16	072018	40	60	465	100	belt rx	unknown	coarse angular material, toe matrix supported slide is healing with grasses and small shrubs shedding sediment along toe (3' high bank)
4	18	072100	80	75	213	100	mm rx	recent harvest	small trees coarse migmatite schist material at toe.
5	8	072118	50	25	300	100	belt rx	unknown	at least three small debris slides along this reach one natural small slump (10% delivery to channel)
6	9	072120	50	30	100	100	belt rx	natural	
7	10	072120	50	30	100	50	belt rx		angular basalt material Gc matrix supported

Sediment scour estimates

Feature	Reach Code	Est. scour depth (ft)	Est. lateral scour (ft)	Time since scour (yrs)	indicator	Notes
1	15	0	10 to 15	over 100 yrs	birch tree (3.5' dbh)	
2	12	0	0 to 5	over 100 yrs	Cedar tree (3.5 to 4 dbh)	lateral scour only cobble/boulder stream bed
3	14	5	0	12-15 yrs	Green Road bridge	not much lateral scour

APPENDIX E JIM FORD CREEK HABITAT SURVEY REPORT

R1/R4 Stream Survey Data Summary for Jim Ford Canyon

Prepared by:
Ann Storrar
NPT Water Resources Division
Lapwai Office
10/12/99

Methodology

The Jim Ford Creek Canyon was surveyed using the R1/R4 Northern and Intermountain Region Fish and Fish Habitat Standard Inventory Procedure (Overton et al. 1997) for approximately 16 % of it's 14.6 mile length. In July 1999 two crews, each comprised of 2 individuals, surveyed approximately 500 feet at intervals separated by 1500 ft, for a total of 21 separate reaches (2.16 miles). Crews received training in techniques prior to the start of survey.

Stream survey data were grouped by channel gradient (steepness) for evaluation due to differing natural, hydrologic functioning at different gradients. A channels have gradients $> 3\%$. B channels are those with gradients of 1.5 to 3.0 %. C channels are those with gradients less than 1.5 %. B channel reaches dominate in the canyon, and comprised 54% of the survey length. A channel reaches comprised 22%, and C channel reaches 24%.

Indicators of habitat condition are rated below as high, moderate, or low quality, according to "Matrix of Pathways and Indicators of Watershed Condition for Chinook, Steelhead and Bull Trout, Local Adaption for the Clearwater Basin and Lower Salmon" (NMFS et al. 1998).

Watershed Condition

Watershed Road Density: Low Quality ($>3\text{mi/sq. mile}$). Road density in lower Jim Ford is 4.58 mi/sq. mile (IDL 1999).

Water Yield: Low Quality ($>20\%$ Equivalent Clearcut Area, ECA). Forestlands ECA = 12,976 acres (20%) of watershed (IDL 1999). An additional 10,662 acres (16%) of watershed is cropland, pasture and rangeland.

Changes in peak/base flow and water yield may occur as a result of agriculture and timber harvest. Trees hold the soil on steep slopes and stabilize stream banks. Well-vegetated hillsides catch the rain and release it slowly. Removing vegetation makes slopes unstable and causes more rapid runoff, which increases soil erosion and carries more sediment to streams. Logging also alters the snowpack size and melting regime. Gaps in the forest are more likely to accumulate snow, releasing larger quantities of water at once when the snow melts. When rain falls or snow melts on compacted soils and devegetated slopes, more water from a wider area runs off quickly into the stream, making storm flows higher. An increase in storm flows is likely

to cause channel erosion and more sedimentation in the stream (Columbia River Inter-Tribal Fish Commission 1999)

Channel Condition and Dynamics

Width/Depth Ratio (wetted width): Predominantly Low Quality (all channel types > 10. Mean = 47; range = 23-98; n=21); indicating sediment accumulation in channels and reduction of stream depth.

Channel Type	Width/Depth Ratio (mean, <i>wetted</i> width to depth)	Overton Natural Condition Volcanic Streams Rating (Varies with channel type and width)	PACFISH Rating (mean wetted width /depth ratio)
A	47	16	Low quality >10
B	46	27	Low quality >10
C	53	10	Low quality >10

Width/Depth Ratio (bankfull width): Predominantly Low Quality (all channel types, as compared to Matrix values shown below).

Channel Type	Width/Depth Ratio (mean, <i>bankfull</i> width to depth)	Matrix Rating - bankfull (varies with channel type)
A	39	Low quality >12
B	46	Low quality >35
C	99	Low quality >60

Streambank Stability: High Quality (A and B channels > 95% stable. C channels >90% stable. Mean = 98; range = 0-100; n = 21).

Habitat Elements

Percent Surface Fines $\leq 6\text{mm}$: High Quality (All channels types $< 10\%$. Mean = 6.3 %; range = 0-19; n = 21).

Channel Type	Percent Fines	Matrix Rating
A	6.5	High quality < 10
B	6.4	High quality < 10
C	4.8	High quality < 20

Large Woody Debris: High Quality (Near-natural levels of acting and potential LWD).

a. Mean volume of LWD = 35 m³/ mile, above PACFISH recommendations of 15.57m³/mile.

b. Mean number of pieces LWD per mile = 44; lower than the Overton et al. (1995) natural condition database value (62 pieces) for B channel types (dominant channel type) in predominantly volcanic geology with 25 feet wetted width.

Channel Type	Wetted width (feet)	Volume (m ³ / mile)	PACFISH Rating	# of pieces/ mile	Overton Natural Condition Volcanic Streams Rating (Varies with chan type and width)
A	26	31	High > 15.57 m ³ / mile	48	Low quality (< 54 pieces/mile)
B	25	33	High > 15.57 m ³ / mile	44	Low quality (< 62 pieces/mile)
C	21	49	High > 15.57 m ³ / mile	42	Adequate amount (> 37 pieces/mile)

Pool Frequency: Predominantly Low Quality (Does not meet PACFISH pool frequency standards). Less than 47 pools/mile for average channel wetted width of 24 feet; mean = 29 pools/mile, range = 9.6-49.0; n=21. However, values are comparable to pool frequency of "natural condition" streams evaluated by Overton et al. (1995)

Channel Type	Wetted width (feet)	# Pools/mile (mean)	Overton Natural Condition Volcanic Streams Rating (varies with channel type and width)		Matrix Rating
			A chan	A volcanic	
A	26	31	8	nd	High quality > 26 pools/mile
B	25	30	24	21	Low quality < 47 pools/mile
C	21	24	21	22	Low quality < 47 pools/mile

Additional Data (not rated by Matrix)

Residual Pool Volume: C channels exhibited significantly lower residual volume than A and B channels ($p=0.25$ and 0.13 , respectively). Volume of C channel pools is 59% of A channel pools; and 55% of B channel pools; indicating pool infilling from coarse sediment loading.

Channel Type	Residual Pool Volume (m^3)
A	129
B	138
C	76

Percent Shade: mean for all reaches = 70%, range 30-89%, n=21.

Channel Type	Mean % Shade
A	81
B	73
C	57

Macroinvertebrates: Data from 1998 BURP samples is unavailable at this time.

Fish Density: Rainbow-steelhead density = $0.02/\text{m}^2$ (Kucera 1984), lowest of 10 NPT Reservation tributaries to the Clearwater River sampled (values ranged from 0.02 - $0.22/\text{m}^2$). NPT 1998 BURP Site at reservation boundary: rainbow-steelhead density = $0.01/\text{m}^2$ and 2 age classes; chinook density = $0.005/\text{m}^2$ and 80-110 mm in length (age 0).

Summary

The general distribution and abundance of fish within a stream or a watershed is regulated by several variables including: temperature, productivity, suitable space, and water quality (DO, turbidity, etc). At specific locations, fish respond to velocity, depth, substrate, cover, predators and competitors. All of the general factors must be within suitable ranges for salmonids during the time they use a stream segment (Bjornn and Reiser 1991). The following discussion summarizes the suitability of habitat in the Jim Ford Canyon for salmonids. While known fish densities are low for the watershed (see above), it is difficult to weigh the limiting effect of any one variable.

Jim Ford Canyon B and C channel types (comprising 16 of the 21 reaches, or 76% of the survey) have fewer pools per mile than high quality habitat as rated by the Matrix (NMFS et al. 1998), the locally adapted reference for evaluating fish habitat quality. However, the pool frequency for all channel types is comparable to Overton et al. (1995) Idaho "natural condition" values for volcanic streams with similar gradients and wetted widths.

Width to depth (wetted) ratios exceed optimal levels for all channel types, although overall streambank stability is high. The bed-material of the canyon reach is dominantly cobble size, containing very little sand to gravel size material. The average d50 for all inventoried segments is 132mm +/- 12%. C channels have a d50 of 69mm, B channels- 118mm, and A channels- 357 mm (Fitzgerald 1999). As the width to depth ratio increases, bank erosion may be accelerated by increasing hydraulic stress against the banks (Rosgen 1996). Evidence of accelerated bank erosion includes undercut, one-hundred year old trees (diameters of 3-4 feet) on channel banks now near toppling into the stream. This high width to depth ratio allows for less effective shading (surveyed C channels had 57% shade), which in addition to the shallow depth results in greater radiant energy absorption. This may drive or contribute to the unsuitable temperatures found in the lower canyon (discussed below). Aggradation in the low gradient reaches also has a barrier effect, decreasing available habitat. Areas of subsurface flow upstream of Green Road Bridge halt fish passage at low flows, restricting fall spawning to lower canyon reaches with the highest temperatures.

Space may be a limiting factor in low gradient canyon reaches, as fish abundance has been shown to be related to pool volume. C channel reaches (low gradient) had the lowest pool frequencies

and significantly lower residual volumes, due to coarse sediment infilling, than A and B channel reaches. A and B channels had similar residual pool volumes. In pools up to 150 m³, the number or biomass of fish observed has been shown to be directly related to the size of the pools (Bjornn and Reiser 1991). Bjornn's (1977) study showed that when sand was added to a natural pool, reducing volume by half and the surface area of water deeper than 0.3m by two-thirds, fish numbers declined by two-thirds.

Spawning substrate in the Jim Ford Canyon is available in sufficient quantities, with the C channel- d50 at 69 mm (Fitzgerald 1999). Optimum substrate size for chinook and steelhead ranges from 13 to 102 mm; and 48-91mm for rainbow trout (Bjornn and Reiser 1991). The percent of fine sediment (< 6mm) is low throughout the canyon, and thus does not impair salmonid spawning. While canyon flows in late summer do not appear limiting to chinook spawning, average depths in B (21cm) and C (15cm) channels are below 30 cm, the optimal depth required for redds by a number of researchers (Bjornn and Reiser 1991).

The amount of large woody debris (LWD) appears adequate by PACFISH standards. However, there is less LWD as compared to similar "natural condition" streams in Idaho (Overton et al. 1995). LWD plays a minor role in pool formation in the Jim Ford canyon, with most pools the result of scouring and plunging flows around boulders and bedrock. The addition of cover (extra depth, preferred substrates, woody debris etc.) increases the complexity of space and the carrying capacity of the stream. Fish abundance has been correlated with the abundance and quality of the cover. The lack of large woody debris associated with pools in Jim Ford may be a contributing factor to low fish densities, as well as the low percentage of undercut banks.

Jim Ford Creek is a productive system with high nutrient levels and thus is not likely to be food-limited for fish. While dissolved oxygen levels in the canyon are unknown, concentrations of dissolved oxygen in small streams may be reduced by large amounts of organic debris when temperatures are high and flows low (Bjornn and Reiser 1991). Growth, food conversion efficiency, and swimming performance will be adversely affected at dissolved oxygen concentrations < 5mg/L, and adult migration has been observed to cease. This should be further assessed in the Jim Ford Canyon for limiting effects on spawning migration and juvenile rearing.

Thermograph temperatures at canyon sites for July through August in 1998 and 1999 exceed 17.8 °C (7-day average of daily maximums), receiving a low quality rating by the Matrix. Daily average temperatures exceed preferred levels for steelhead (10-13 °C) and chinook (12-14 °C) at canyon sites below Green Road Bridge for July through mid-August both years. Several sites (mouth, NPT boundary, and Green Road Bridge) approach the upper lethal limit for steelhead (23.9 °C) during these months. Immediately below the waterfall in the upper portion of the canyon, temperatures for July and August 1999, were predominantly within the preferred range for salmonids. It is unknown how far downstream toward Green Bridge this temperature regime prevails. Thermographs show a 4.45 degree heat gain (comparing 7/1-8/31 averages for 1999) between the waterfall (14.7°C) and Green Bridge (19.1°C). Downstream of the bridge, heat gain

or loss is minimal, with the NPT boundary average at 19.1°C, and the mouth at 19.1°C for same time interval.

The percent shading (evaluated by canopy cover angle) throughout the canyon is 70% overall, with A channel levels at 81%, B channels at 73%, and C channels at 57%. Generally, 80 % shade is considered adequate for maintaining stream temperature. The canyon contains predominantly mature, undisturbed canopy and riparian buffers due to steep terrain with limited access.

Conclusions

Management practices in the watershed have likely exacerbated the natural sediment regime, with accumulation at levels which degrade salmonid habitat. Channels are wider and shallower than optimal. Low gradient reaches have reduced pool volumes due to infilling with coarse sediment. The introduction of bedload sediment and resulting increase in stream surface area increases the amount of solar radiation entering the stream contributing to the unsuitable temperatures found in the lower canyon.

Road density for this watershed is considered high (4.58 mi/sq. mile) by many researchers (NMFS et al. 1998), and has likely contributed to stream sediment loading, in addition to natural landslides and the building of the power plant. Grazing impacts in the canyon are thought to be low, and no mining has occurred.

Recommendations

Measures should be taken to reduce overall sediment loading in this watershed. In addition, riparian buffers should be restored where indicated to meet desirable density and canopy cover goals.

- Assess and diminish management related sediment sources where possible.
- Identify unneeded roads and decommission or obliterate.
- Maintain the existing road system to ensure stability of components, including cutslopes, fill slopes, drainage system, and surface.
- Develop guidelines for land management in canyon, incorporating practices which reduce erosion and risk of landslides.

Significance of Habitat Parameters—See Appendix B.

These are provided to assist with interpretation of results in order to illustrate the significance of the parameters evaluated. Not all parameters discussed are limited or impaired in the Jim Ford Watershed.

References

The references in this Appendix are all provided in either Appendix B or Section 5.0 with the following additions:

Fitzgerald, Jim. 1999. Personal oral communication between Jim Fitzgerald of U.S. EPA Boise Office and Ann Storrar of NPT Lapwai Office.

[NMFS] National Marine Fisheries Service, Cottonwood Creek BLM, Clearwater National Forest, Nez Perce National Forest. 1998. "Matrix of Pathways and Indicators of Watershed Condition for Chinook, Steelhead and Bull Trout," Local Adaptation for Clearwater Basin and Lower Salmon.

Overton, C.K., S.P. Wollrab, B.C. Roberts, and M.A. Radko. 1997. R1/R4 (Northern/Intermountain Regions) Fish and Fish Habitat Standard Inventory Procedures Handbook). United States Department of Agriculture Forest Service Intermountain Research Station. General Technical Report INT-GTR-346.

Rosgen, D.L. 1996. Applied river morphology. Wildland Hydrology, Pagosa Springs, CO.

APPENDIX F TECHNICAL DOCUMENTATION OF INSTREAM LOADING ANALYSIS FOR COARSE SEDIMENT TMDL

prepared by
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Introduction

The goal of the Jim Ford Creek coarse sediment TMDL is to stabilize the response reaches which, in turn, is expected to improve salmon rearing habitat. The analysis framework used to develop this TMDL presumes that actions taken to stabilize the channel will reduce the width to depth ratio and increase the residual pool volume. The purpose of this appendix is to report the methods, conceptual model, data, and results of the instream coarse sediment loading analysis.

Available evidence suggests that the response reaches of lower Jim Ford Creek are aggrading as a result of excess water and coarse sediment inputs. This evidence includes: 1) braided channels; 2) overflow channels eroding flood plain; 3) frequent channel migration; 4) channel widening; 5) surface debris (e.g. vegetation) buried; and 6) substantial channel changes measured over last 20 years (i.e. photogrammetry). It is possible that these response reaches naturally store large amounts of coarse sediment given the watershed geology and morphology. Some natural instability likely occurs in this reach, however, channel stability and habitat data indicate that bedload transport occurs more frequently than would be expected under natural conditions and negatively impacts water temperature and salmon habitat.

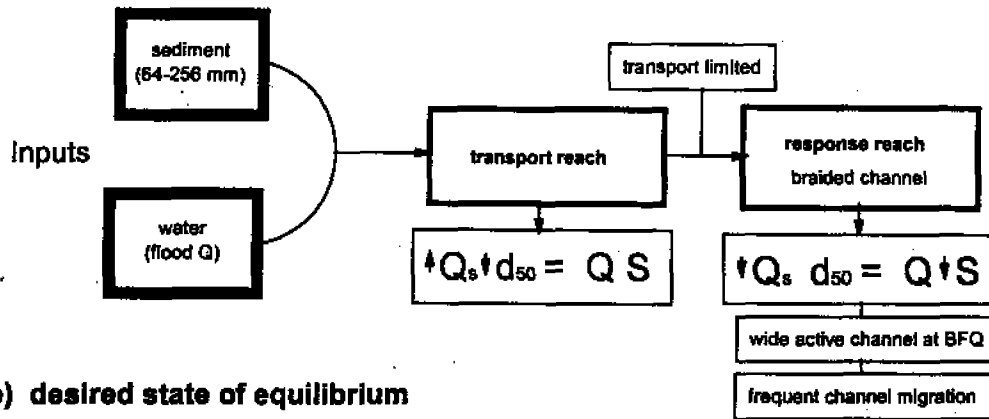
This instream loading analysis estimates how much the bedload transport needs to be reduced to help the response reaches stabilize. A qualitative conceptual model and quantitative bedload transport analysis are used to help answer this question.

Methods

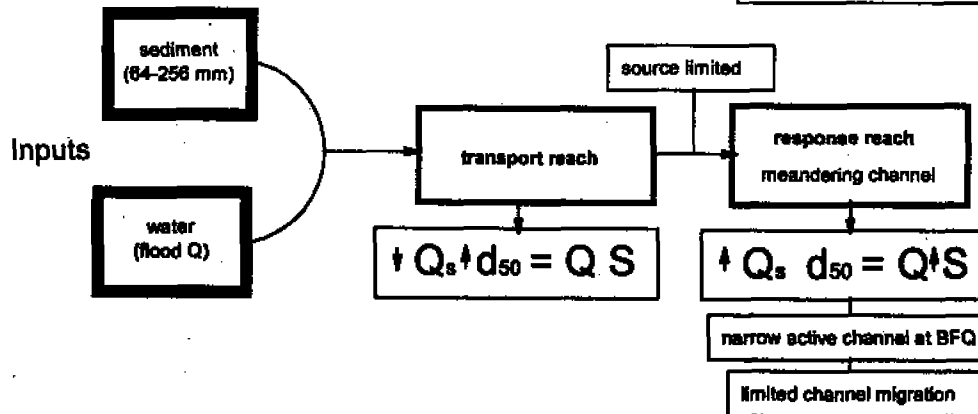
This section describes the methods used to develop the coarse sediment loading analysis. This analysis uses a bankfull flow and bedload transport analysis to estimate the present and desired bedload transport rates. One-dimensional flow and bedload transport equations are used to estimate the existing reach average flow competence (i.e. largest particle size moved at bankfull flow) and bedload transport rates for a range of d_{50} particle sizes. They are then used to estimate the reach average bedload transport rate needed to increase the reach average d_{50} particle size.

The stream flow analysis uses USGS regional regression equations to estimate bankfull flow (see Hydrology Section 2.1.3 for details). Jim Ford Creek has not been gaged so no actual bankfull flow values are available to verify this estimate. The estimated bankfull flow of lower Jim Ford Creek is about 170 cfs.

a) present state of equilibrium



b) desired state of equilibrium



F-1. Flow chart illustrating conceptual model of sediment and energy inputs and channel response: a) model of present state of equilibrium; and b) model of desired state of equilibrium. The Lane equations describe the balance between sediment and water inputs and the response of the channel. The variables are defined as: 1) Q_s is bed-material load; 2) d_{50} is the median particle size of the bed-material; 3) Q is bankfull discharge; and 4) S is stream gradient.

The following steps are used to apply the bedload transport equations. First, results from the flow analysis are used to estimate the reach average boundary shear stress (i.e., force available to transport sediment) which is a depth-slope product. Second, the bedload transport rates for present and desired substrate conditions are estimated using the Parker-1982 and Parker-1990 bedload equations. The equations and their variables are not listed here. The computer program WinXSPRO is used to calculate stream discharge and bedload transport rates. For descriptions of the equations refer to USDA Forest Service (1997) and Reid and Dunne (1996).

The one-dimensional flow and bedload transport equations make the following assumptions: 1) constant width, depth, area, and velocity; 2) water surface slope and energy grade line approach

the slope of the streambed; 3) streamlines are parallel and straight; and 4) channel uniform, with no obstructions (e.g., boulders) or backwater. Bedload transport equations assume the following as well: 1) constant reach average d_{50} particle size, depth, and slope at bankfull discharge; 2) surface and subsurface d_{50} particle sizes are similar; 3) equal mobility of the streambed; and 4) bankfull discharge is the channel maintaining flow and flood discharge is the channel changing flow.

Conceptual Model

This section describes the qualitative conceptual model and quantitative bedload model used to develop this TMDL. The qualitative conceptual model of lower Jim Ford Creek presumes that by reducing the bedload transport rate of transport reaches, the response reaches will be allowed to develop a more stable meandering channel geometry (Figure F-1). This model assumes that the bed-material texture, bed shear stress, and transport capacity are a result of long term sediment and water inputs, and that as the sediment supply changes, so does the bed-material texture. When the bedload transport capacity is greater than supply, winnowing and textural coarsening of the bed-material result, and the bedload transport rate is reduced (Montgomery and Buffington 1999). This conceptual framework supports the following bedload transport analysis.

The quantitative bedload model uses a design fluvial sediment analysis for an alluvial channel to estimate the bedload transport rate through transport reaches. This analysis models bedload transport for the present and desired state of channel equilibrium (Figure F-1).

Because of the temporal and spatial complexities of bedload movement, it is difficult to accurately model the bedload transport rate of natural stream systems. To maximize the bedload model output, and support the linkage between the instream targets and the coarse sediment load capacity, the qualitative conceptual model assumes the following: 1) reducing the bedload input to transport reaches will increase the d_{50} particle size as winnowing removes the finer material; 2) to increase the d_{50} particle size of transport reaches there needs to be less input of finer bed-material (i.e., < 90 mm); 3) increasing the size of the d_{50} particle size of transport reaches will reduce the bedload input to response reaches; 4) reducing the bedload input to response reaches will reduce the rate of aggradation, stabilize the stream bed, and reduce the frequency of channel migration; 5) stabilizing the response reaches will result in a shift from a braided channel to a meandering channel type; and 6) shifting to a meandering channel type will cause the width to depth ratio to decrease and the residual pool volume to increase.

In addition to water and sediment, woody debris and riparian vegetation influence channel stability. This analysis accounts for the role of organic material by assuming the following: 1) as the bedload transport rate is reduced, the density of riparian vegetation will increase and will facilitate a more stable channel geometry; and 2) as the amount of instream woody debris increases, the channel roughness will increase, and the force available to transport bedload will decrease (Buffington and Montgomery 1999).

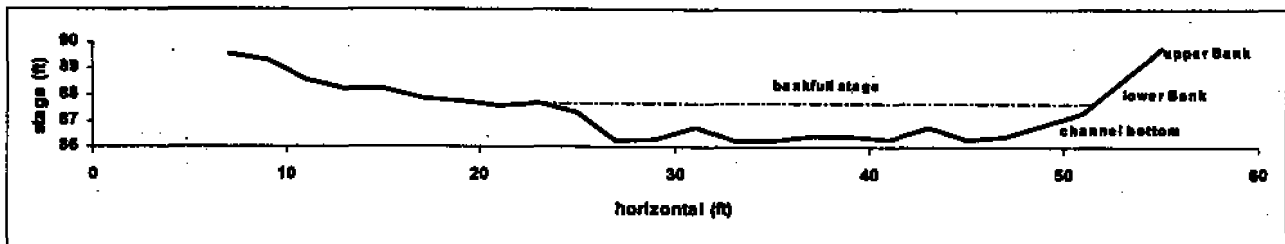
Data

This section describes the data used to model bedload transport. Channel geometry data collected as part of the channel stability inventory are used in this model. For a summary of these data refer to Appendix D. Rather than model every transport reach of lower Jim Ford Creek, a "design" reach is chosen and channel geometry parameters are averaged over this reach. The input variables are listed in Table F-1. As stated above, all bedload modeling is done at bankfull discharge.

Table F-1. Flow and Bedload Transport Equations Input Variables

Parameter	Value
Stage (ft)	2.1
Area (ft ²)	55
Wetted Perimeter (ft)	42
Width (ft)	41
Hydraulic Radius (ft)	1.3
Hydraulic Depth (ft)	1.4
Slope	0.02
Roughness (n)	0.08
Mean Velocity (ft/s)	3.0
Bankfull Discharge (cfs)	170

Figure F-2. Typical transport reach channel cross-section (no vertical exaggeration).



Transport reaches tend to be in alluvial confined valleys and have limited flood plain access. Figure F-2 illustrates the typical channel geometry of transport reaches. As reported in Appendix D, there is a range of measured d_{50} particle size for transport reach: therefore, three different d_{50} particle sizes are modeled and compared to the desired d_{50} to estimate the needed bedload transport rate reductions. These particle sizes are: 1) 64 mm; 2) 90 mm; and 3) 118 mm.

Results and Discussion

This section reports the results of bedload modeling and discusses the findings and conclusions. In summary, the estimated bankfull flow of lower Jim Ford Creek is used to model bedload transport through the "design" transport reach (Figure F-2). Results from the modeling are presented in Table F-2.

Bedload modeling indicates that, in theory, to increase the bed-material d_{50} particle size from 64 to 128 mm, the bedload transport rate needs to be reduced about 98%. If the existing and desired bedload transport rates are taken as the average of the two Parker equations, the bedload transport rate needs to be reduced between 70 and 100% depending on the bed-material d_{50} particle size used in the equation. Because the average measured d_{50} particle size of transport reaches is 118 mm, a 70% reduction in bedload transport is used in the TMDL to allocate sediment reductions.

Given the present bankfull discharge, results from these equations indicate that substantial reductions of bedload transport are needed to achieve the target conditions. The reported bedload transport rates are considered rough estimates of actual conditions. Moreover, other flows (e.g., extreme flood events) which transport large quantities of material are not factored into this analysis. The uncertainty of these estimates is reduced by the assumptions made in the conceptual model, however, it is unlikely that this analysis provides reach specific mitigation alternatives as far as channel stability and salmon habitat quality. Results from the Sediment Source Analysis Framework will be used to revise these estimates and provide specific management alternatives needed to stabilize lower Jim Ford Creek (see TMDL Administrative Record for details).

Table F-2. Bedload Modeling Results

Qbf (cfs)	170				Percent Reduction		
d50 (mm)	64	90	118*	128^			
transport rate	t/d*	t/d	t/d	t/d	(64mm)	(99mm)	(118mm)
Parker (1990)	5063	706	43	9	100	99	79
Parker (1982)	5789	1642	107	36	99	98	66
Average	5426	1174	75	23	100	98	70

*t/d - tons/day

= measured average d_{50} particle size of transport reaches

^ = desired condition

References

- Buffington, J.M. and D.R. Montgomery 1999. Effects of hydraulic roughness on surface textures of gravel-bed rivers. *Water Resources Research*, Vol. 35, No. 11, p. 3507-3521.
- Harrelson, C.C., C.L. Rawlins, and J.P. Potyondy. 1994. Stream channel reference sites: an illustrated guide to field technique. General Technical Support, RM-245, U.S. Department of Agriculture, Forest Service.
- Ried, L.M. and T. Dunne. 1996. Rapid Evaluation of Sediment Budgets. Catena Verlag GMBH. Germany.
- USDA Forest Service, 1997. WinXSPRO, a channel cross-section analyzer, user's manual. Rocky Mountain Experiment Station, Fort Collins, CO. phone # (970) 498-1170.

APPENDIX G SUPPLEMENT TO TEMPERATURE TMDL

Prepared by Ann Storrar,
NPT Water Resources Division Lapwai Office, and
Curry Jones, EPA, Seattle
11/4/99

G-1. Jim Ford Shade Evaluation

Methods

Shade percentages for the Jim Ford Watershed were determined using aerial photo interpretation (Washington Forest Practices Board, 1997) in conjunction with field validation. Weighted averages of percent shade by segment length were determined from aerial photos, for approximately 110 stream miles, including mainstem Jim Ford Creek and its tributaries.

In order to provide a measure of certainty to the photo interpretation values, field verification was conducted through stream surveys. The angle of canopy cover was recorded by field crews during an R1/R4 Fish Habitat Survey of the lower Jim Ford canyon in July, 1999. The canyon was surveyed at base flow, for 500 foot intervals separated by 1500 feet, for a total of 21 separate reaches (2.16 miles) of its 14.6 mile length. The angle of canopy cover in degrees, on both sides of the channel was recorded, as viewed with a clinometer, from the center point of each habitat unit (Platts et al. 1983).

No significant difference was found in percent shade when the 21 mean, reach values from stream surveys were compared with the corresponding aerial photo values ($p=0.041$). See attached Figure G-1 for Jim Ford shade percentages.

G-2. Thermograph Monitoring Locations

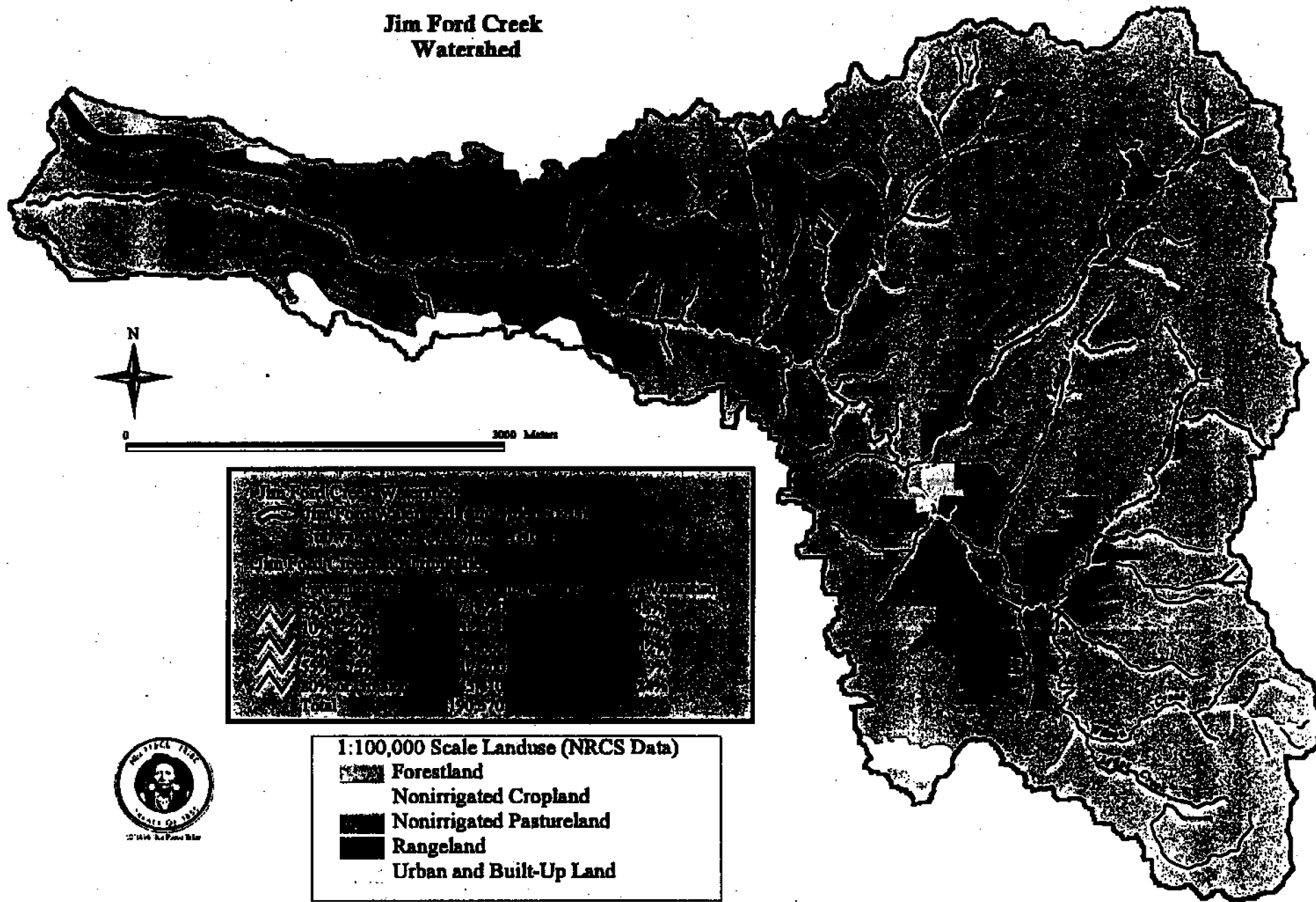
Thermograph monitoring locations for 1998 and 1999 temperature monitoring are shown on Figures G-2 and G-3, respectively.

G-3. Streamflow and Channel Dimensions

Streamflow measurements were obtained from field sheets used in the Idaho Beneficial Use Reconnaissance Project (BURP), as no gage information was available. The BURP process includes channel dimensions (width, depth, slope) and instantaneous streamflow measurements (summarized in Appendix C). Stream channel cross-section information, and channel gradient were used to calibrate and run the SSTEMP model.

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Jim Ford Creek Watershed



0 3000 Meters

Jim Ford Creek Watershed
 1:100,000 Scale Landuse (NRCS Data)
 1995-2000

Land Use Category	Area (Hectares)	Percentage (%)
Forestland	10,200	52.3
Nonirrigated Cropland	1,200	6.2
Nonirrigated Pastureland	1,200	6.2
Rangeland	1,200	6.2
Urban and Built-Up Land	1,200	6.2
Total	19,570	100.0

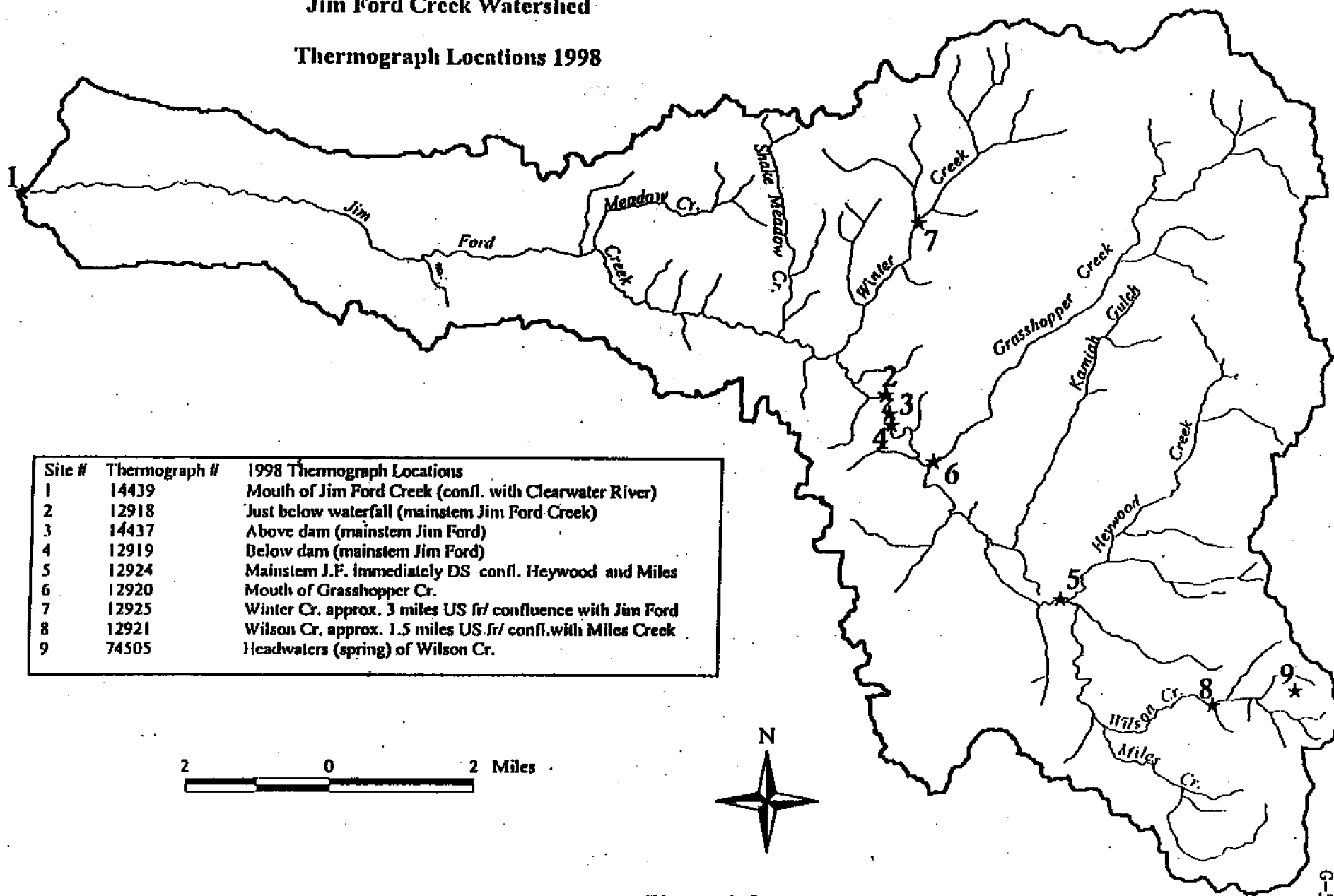


1:100,000 Scale Landuse (NRCS Data)

- Forestland
- Nonirrigated Cropland
- Nonirrigated Pastureland
- Rangeland
- Urban and Built-Up Land

Jim Ford Creek Watershed

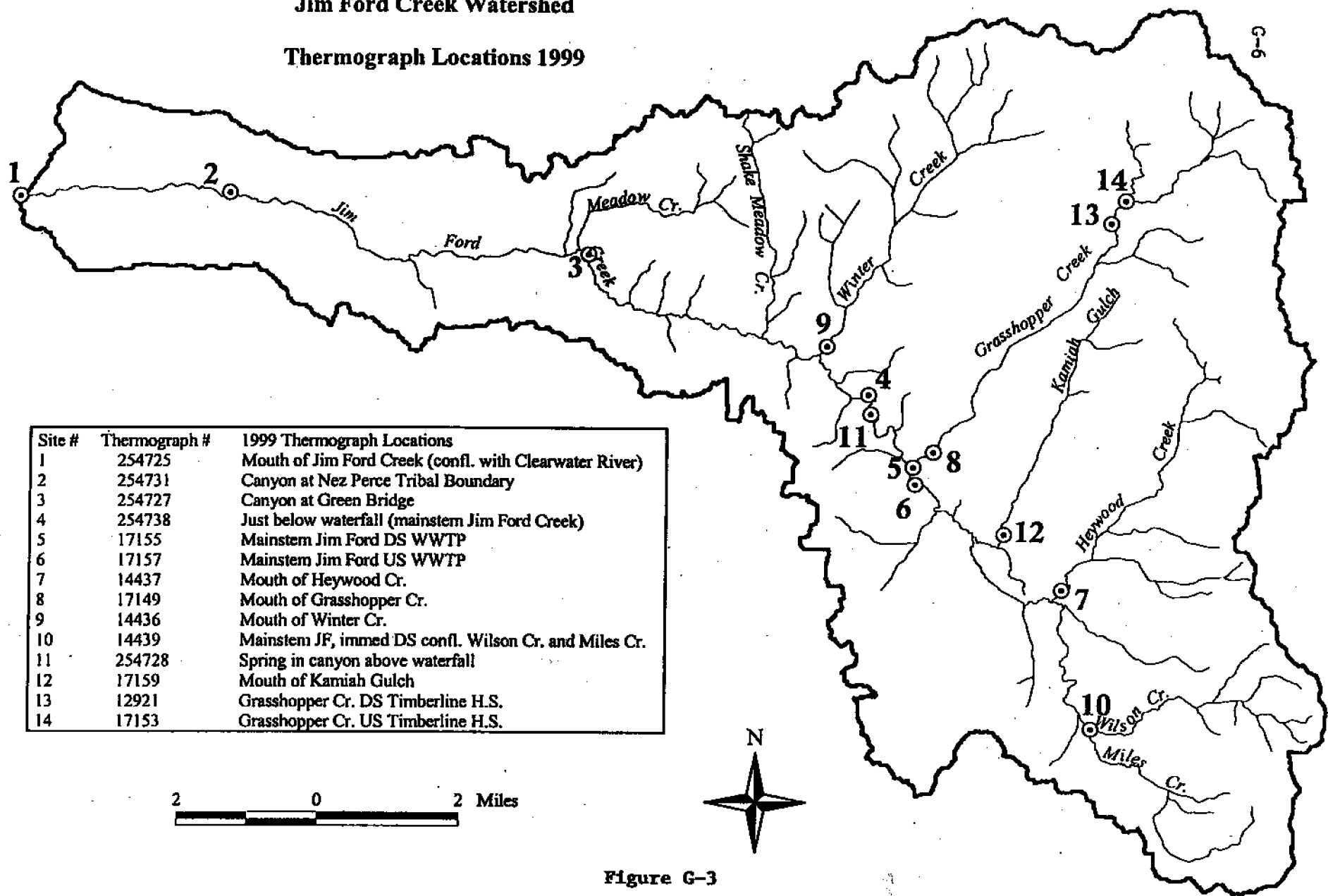
Thermograph Locations 1998



Site #	Thermograph #	1998 Thermograph Locations
1	14439	Mouth of Jim Ford Creek (confl. with Clearwater River)
2	12918	Just below waterfall (mainstem Jim Ford Creek)
3	14437	Above dam (mainstem Jim Ford)
4	12919	Below dam (mainstem Jim Ford)
5	12924	Mainstem J.F. immediately DS confl. Heywood and Miles
6	12920	Mouth of Grasshopper Cr.
7	12925	Winter Cr. approx. 3 miles US fr/ confluence with Jim Ford
8	12921	Wilson Cr. approx. 1.5 miles US fr/ confl. with Miles Creek
9	74505	Headwaters (spring) of Wilson Cr.

Figure G-2

Jim Ford Creek Watershed
Thermograph Locations 1999



G-4 Atmospheric Condition Data

Atmospheric condition data needed to calibrate and model the subwatersheds in SSOLAR and SSTEMP included air temperature, wind speed, relative humidity, and cloud cover. Air temperature data was made available from the National Climatological Data Center for Weippe, Pierce, and Dworshak, Idaho. Each subwatershed was modeled using data from the station of most similar elevation. Daily maximum and minimum air temperatures were averaged for each day for the entire period of record. The average monthly air temperature was the temperature used in the modeling analysis (Table G-1).

The National Oceanic Atmospheric Administration Climatic Atlas was used to estimate wind speed and relative humidity. Values included: an average monthly wind speed of 8 mph for the month, and relative humidity ranging from 20 - 40%, corrected for subwatershed elevation.

Table G-1. Mean Air Temperature for Salmonid Spawning and Rearing Time Period
Mean Monthly Air Temperature 1963-1998

Month	Weippe, Idaho	Pierce, Idaho	Dworshak, Idaho
January	25.37263034	25.373	32.5031
February	28.58773432	28.58	38.0269
March	33.78527835	33.785	44.5149
April	40.61311898	40.613	51.0734
May	49.30528727	49.305	58.88
June	56.0960924	56.096	65.7469
July	62.18563317	62.186	72.559
August	61.36709483	61.367	72.5892
September	52.23482379	52.235	63.4715
October	42.47023769	42.47	51.4912
November	32.34355097	32.344	40.2612
December	25.05485869	25.055	33.4467

G-5 Frequently Occurring Stream Temperature

Frequently occurring stream temperatures were evaluated for each sub-watershed. Thermograph data for the July 1st - August 16th time period were sorted into temperature groups and the frequency of occurrence determined (Figure G-4). The frequency distribution charts (Figure G-5a through G-5e) below represent the data used to determine most frequently occurring stream temperatures.

Original Hobo Temp Data

Date	Mainstem Jim Ford (12924)
6/12/98	17.214
6/13/98	15.98087
6/14/98	15.63287
6/15/98	15.14087
6/16/98	12.0367
6/17/98	13.90333
6/18/98	16.99333
6/19/98	14.378
6/20/98	14.09133
6/21/98	16.51487
6/22/98	17.17487
6/23/98	17.48867
6/24/98	16.88133
6/25/98	15.644

Data
Sorted into
Groups

Temperature (C)	Frequency Distribution	Percentage
5	1	1%
6	1	1%
7	0	0%
8	0	0%
9	0	0%
10	0	0%
11	2	2%
12	7	6%
13	1	1%
14	7	6%
15	7	6%
16	7	6%
17	17	15%
18	9	8%
19	7	6%
20	20	18%
21	19	17%
22	6	5%
23	0	0%
24	0	0%
25	0	0%
26	0	0%
	111	100%

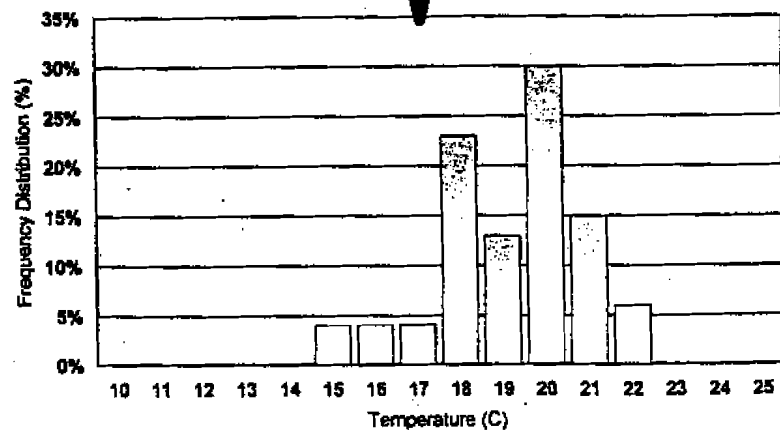


Figure-G4

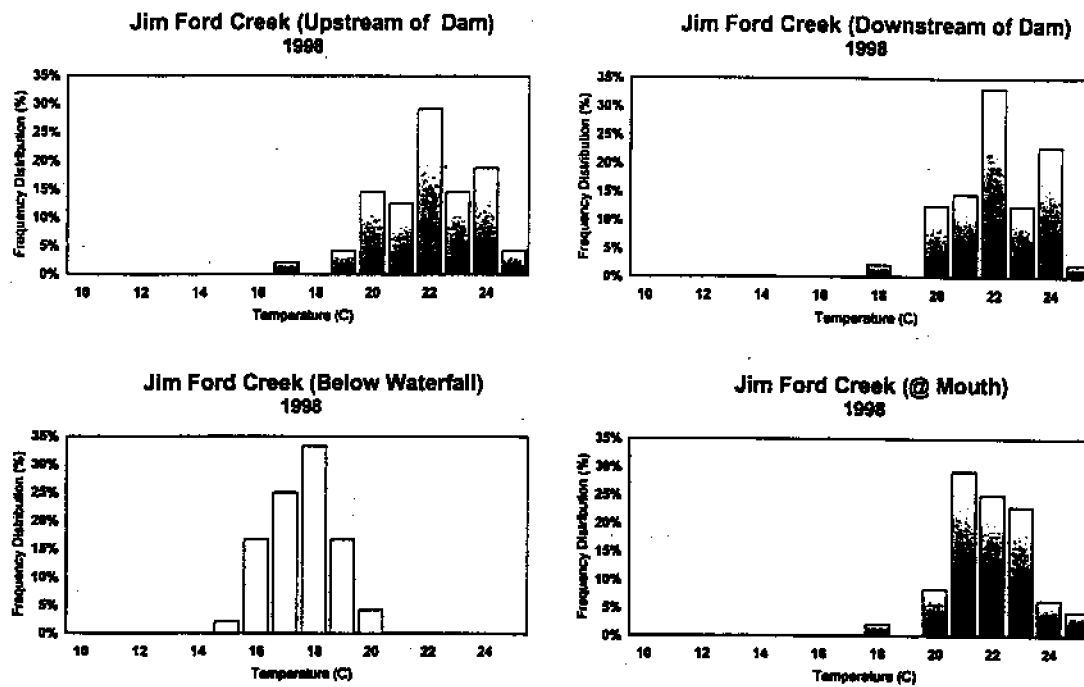


Figure G5-a

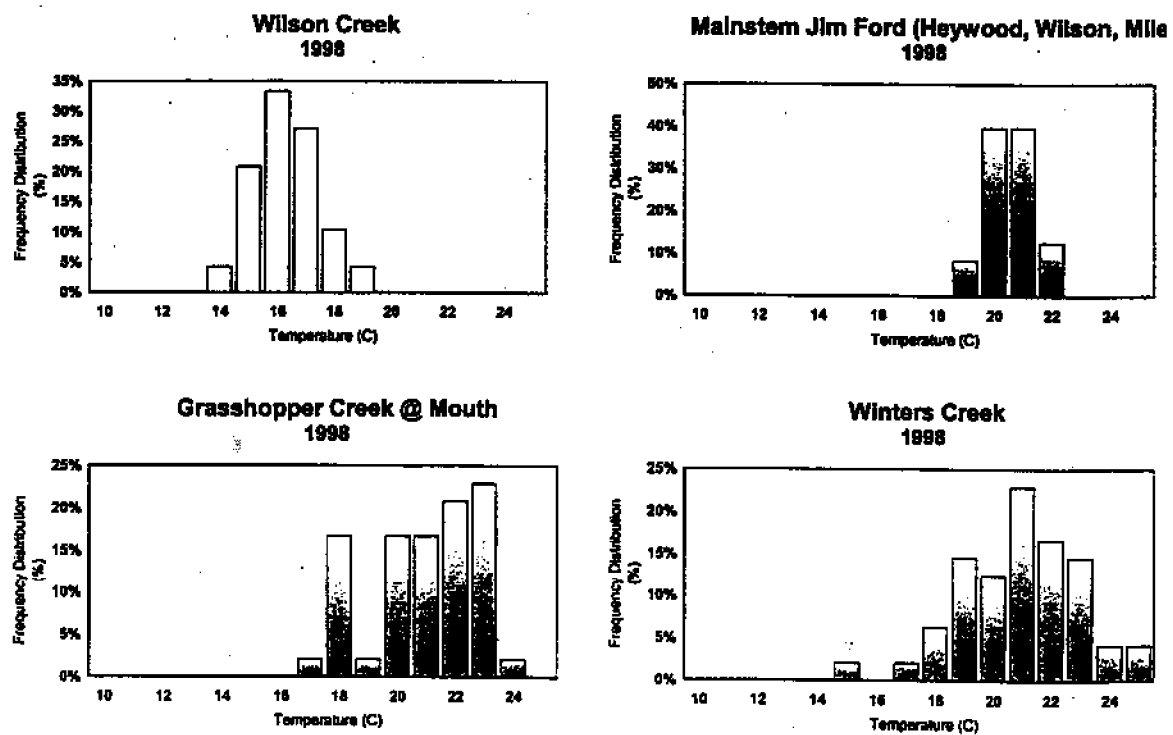


Figure G-5b

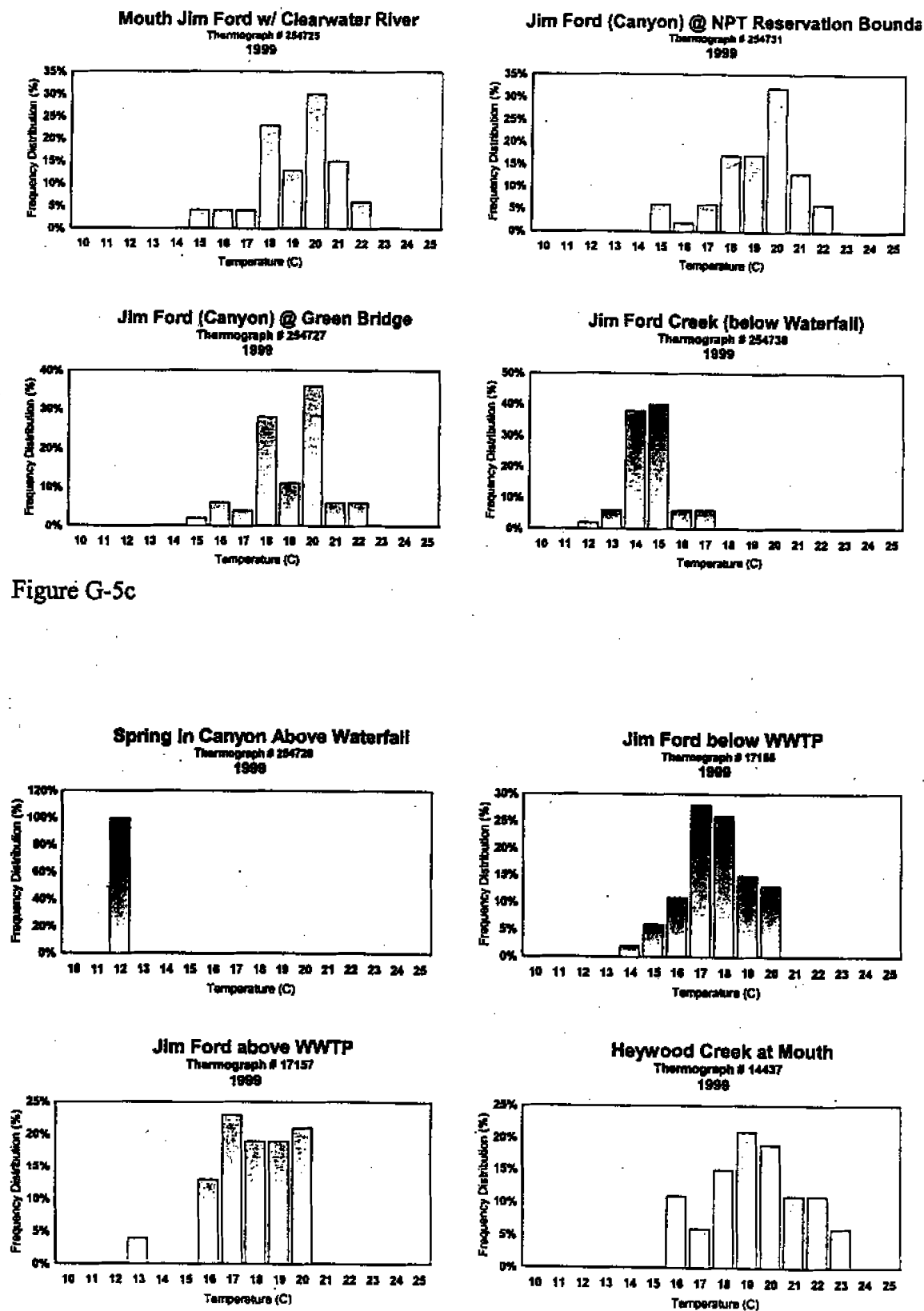


Figure G-5d

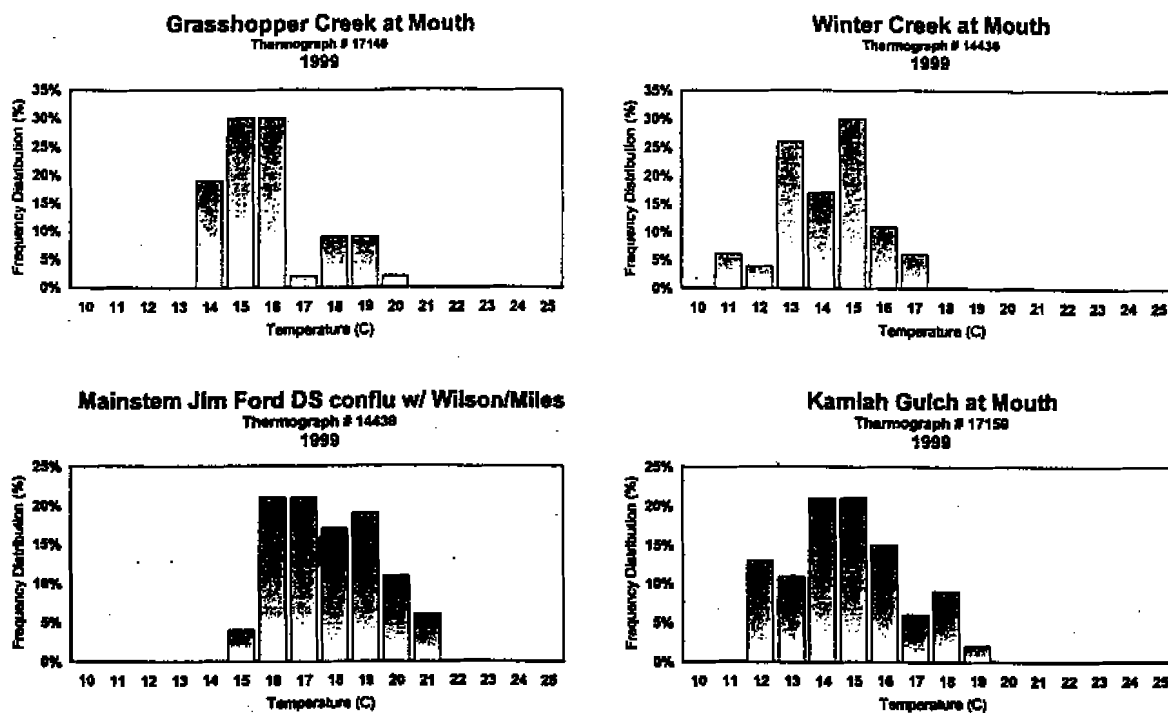


Figure G-5e

G-6 Point Source - Timberline High School

Thermographs were placed both upstream and downstream of the discharge from Timberline High School. A Students T-test shows no significant difference in stream temperature above and below Timberlines' discharge ($p < 0.05$). This information is summarized in Table G-2 below.

Table G-2. Grasshopper Creek (Timberline High School) Temperature Assessment

Date	Daily Average Stream Temperature			Upstream/Downstream of Timberline High School		
	US of Timberline High School	DS of Timberline High School	Mouth of Grasshopper			
6/9/99	10.583	12.057	12.369	2 Tailed T-Test	0.00003135	($p < 0.05$) No Significant Difference
6/10/99	12.417	12.37	13.726	2 Tailed T-Test	0.000028142	($p < 0.05$) No Significant Difference
6/11/99	14.43	14.399	15.565			

G-12

Date	US of Timberline High School	DS of Timberline High School	Mouth of Grasshopper			
6/12/99	15.384	15.414	17.052			
6/13/99	15.483	15.547	16.863			
6/14/99	16.393	16.422	18.083			
6/15/99	18.485	18.657	20.723			
6/16/99	20.177	20.485	21.934			
6/17/99	20.816	21.06	22.194			
6/18/99	19.452	19.761	21.085			
6/19/99	18.404	18.532	20.037			
6/20/99	17.155	17.313	18.808			
6/21/99	16.275	16.303	17.405			
6/22/99	15.137	15.135	16.657			
6/23/99	16.049	15.998	17.768			
6/24/99	16.088	16.258	18.052			
6/25/99	14.164	14.261	16.021			
6/26/99	13.66	13.551	15.3			
6/27/99	14.775	14.63	16.305			
6/28/99	14.184	14.134	15.957			
6/29/99	15.064	15.092	16.614			
6/30/99	15.799	15.877	17.133			
7/1/99	15.582	15.624	17.074			
7/2/99	13.901	14.07	15.609			
7/3/99	13.489	13.421	15.291			
7/4/99	13.589	13.635	15.293			
7/5/99	13.606	13.47	15.793			
7/6/99	15.489	15.798	18.322			
7/7/99	16.64	16.723	18.856			
7/8/99	15.408	15.719	17.519			
7/9/99	15.881	16.094	18.075			
7/10/99	16.499	16.747	18.67			

Date	US of Timberline High School	DS of Timberline High School	Mouth of Grasshopper			
7/11/99	17.585	17.877	19.476			
7/12/99	18.227	18.458	19.684			
7/13/99	18.404	18.6	19.487			
7/14/99	17.935	17.782	18.052			
7/15/99	16.369	16.283	15.882			
7/16/99	15.704	16.02	15.319			
7/17/99	16.26	16.496	15.709			
7/18/99	16.561	16.751	15.378			
7/19/99	16.34	16.661	14.97			
7/20/99	17.266	17.661	15.659			
7/21/99	17.244	17.25	16.1			
7/22/99	16.804	17.341	16.151			
7/23/99	17.521	17.744	15.845			
7/24/99	16.813	16.32	15.591			
7/25/99	15.03	15.534	14.542			
7/26/99	15.66	15.952	14.134			
7/27/99	16.628	17.221	14.54			
7/28/99	17.714	18.258	14.944			
7/29/99	18.112	18.461	14.992			
7/30/99	17.407	17.543	14.351			
7/31/99	16.977	17.24	13.946			
8/1/99	16.784	17.066	13.636			
8/2/99	17.522	18.16	14.24			
8/3/99	18.37	18.532	14.928			
8/4/99	19.307	19.478	15.543			
8/5/99	19.611	19.888	15.782			
8/6/99	19.71	20.015	15.796			
8/7/99	19.289	19.144	15.891			
8/8/99	17.567	17.861	14.802			

Date	US of Timberline High School	DS of Timberline High School	Mouth of Grasshopper			
8/9/99	17.07	17.176	14.226			
8/10/99	17.217	17.448	14.147			
8/11/99	18.096	17.887	15.228			
8/12/99	17.119	17.458	14.786			
8/13/99	16.51	16.114	14.692			
8/14/99	13.976	14.069	13.805			
8/15/99	14.448	14.67	13.635			
8/16/88	14.948	15.261	15.682			
8/17/99	15.893	16.069	16.292			
8/18/99	16.464	16.796	16.659			
8/19/99	17.776	18.358	17.005			
8/20/99	17.503	17.642	15.639			
8/21/99	17.486	17.54	15.433			
8/22/99	16.718	16.617	14.507			
8/23/99	16.209	16.111	14.024			
8/24/99	16.527	16.537	14.474			
8/25/99	16.576	16.71	14.272			
8/26/99	16.56	16.712	14.225			
8/27/99	16.734	16.614	14.445			
8/28/99	16.94	16.785	14.584			
8/29/99	17.037	17.282	14.692			
8/30/99	15.631	15.027	14.491			
8/31/99	16.71	15.712	15.904			
Mean	16.4915	16.6280	-0.14			

G-7. References

Platts W.S., W.F. Megahan, and G.W. Minshall. 1983. Methods for evaluating stream, riparian, and biotic conditions. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden Utah.

USGS; 1987. IF312 The Stream Temperature and Stream Network Temperature Models.

Washington Forest Practices Board, Washington Forest Practices Board Manual: Standard Methodology for Conducting Watershed Analysis, November 1997

APPENDIX H WATERSHED RESTORATION STRATEGY

Overview

The Jim Ford Creek Total Maximum Daily Load (TMDL), developed under an existing Memorandum of Agreement between the Nez Perce Tribe, the Environmental Protection Agency (U.S. EPA), and the State of Idaho Department of Environmental Quality (IDEQ) was established to restore beneficial uses and achieve State water quality standards. The temperature component of the Jim Ford Creek TMDL establishes a percent reduction target in instream temperature and a corresponding "*Percent Increase In Shade*" target for each sub-watershed. These targets, over time, will ensure reasonable progress toward the attainment of the water quality criteria and protection of sensitive fish species in the Jim Ford Creek watershed.

The Jim Ford Watershed Advisory Group (WAG) has participated in developing a Watershed Restoration Strategy (WRS) to ensure reasonable progress toward attainment of water quality standards through watershed improvement projects, restoration activities and management practices. As presented in Figure H-1, the structure and success of the WRS implementation rely heavily on the cooperation of landowners in the watershed. Once the strategy is complete, measures identified will be used to develop the analytical component of the temperature TMDL for nonpoint sources in the watershed. The streams affected by this plan include:

- | | |
|--|--------------------------------------|
| ◆Wilson Creek, Headwaters to Mouth | ◆Jim Ford Creek, Headwaters to Mouth |
| ◆Heywood Creek, Headwaters to Mouth | ◆Miles Creek, Headwaters to Mouth |
| ◆Grasshopper Creek, Headwaters to Mouth | ◆Winter Creek, Headwaters to Mouth |
| ◆Shake Meadow Creek, Headwaters to Mouth | ◆Kamiah Gulch, Headwaters to Mouth |

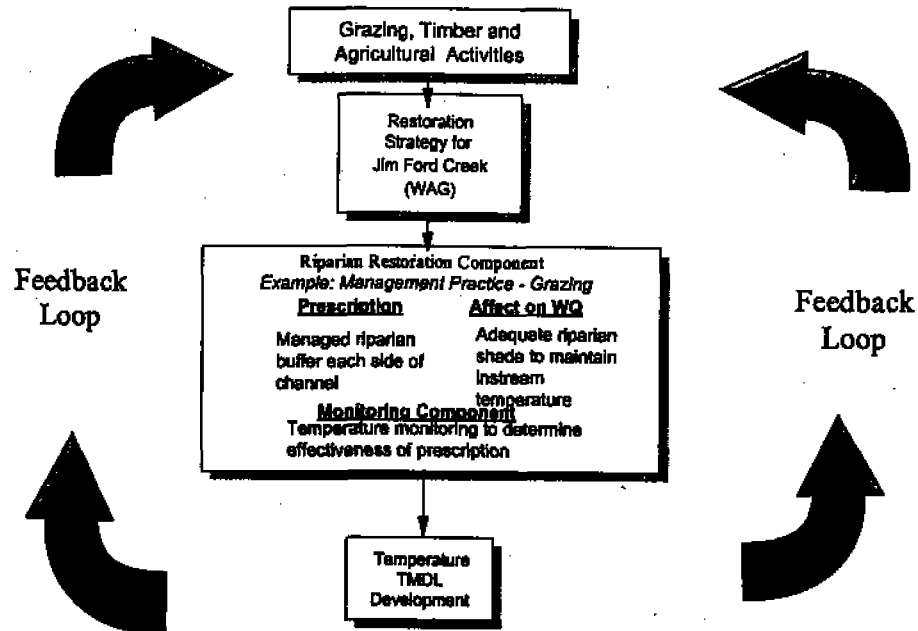


Figure H-1- Riparian Restoration Strategy and Feedback Process

Problem

Streams in the Jim Ford Creek watershed are impaired due to excess heating causing temperature exceedences. Stream temperature is an expression of heat energy per unit volume of water. Temperatures can increase as a result of land management activities which alter basic watershed processes. Stream temperature is affected by the amount of water surface area exposed to direct solar radiation (i.e. sunlight), which is absorbed and dissipated as heat. Land management practices may result in water temperature increases through the process described in Tables H-1 and H-2.

Table H-2 identifies watershed conditions in Jim Ford Creek and their effect on water quality and the human-caused sources attributed to the condition(s).

Table H-1 - Watershed Conditions in Jim Ford and Their Effects on Water Quality

Watershed Condition	Description	NPS pollution: relation to watershed condition	Human-Caused Sources of Watershed Condition
I. Riparian area in sub-optimal condition	A. Streambank shade less than 20 percent	High stream temperature: Increased exposure to sun allowing solar heating	<ul style="list-style-type: none"> • Historic domestic livestock grazing practices with high concentrations or overuse during critical growing season resulting in loss of species diversity, especially riparian woody species • Low level management of livestock • Timber removal • Reduction of wetlands, increased depth to groundwater • Conversion of wetland meadows to pasture and cropland • Removal of shrubs along ditches and streams • Removal of beaver resulting in lower water table
	B. Less than 80 percent streambank stability	High stream temperature: streambank erosion resulting in widening of stream allowing increased solar heating; reduced shade from overhanging banks; low summer flows and reduced cool ground water inflow	<ul style="list-style-type: none"> • Historic domestic livestock grazing practices with high concentrations or overuse during critical growing season resulting in increase of nonriparian herbaceous species with shallower and fewer roots; high concentrations or overuse during periods when streambanks are saturated and vulnerable to trampling or chiseling • Stream channelization, straightening • Removal of shrubs along ditches and streams stabilizing banks • Woody debris removal
	C. Reduced riparian vegetation acting as buffer, filter, and sediment trap.	Sediment, suspended solids, nutrients, and bacterial input resulting in reduced water quality	<ul style="list-style-type: none"> • Wildfires • Construction of drainage ditches • Stream channelization, straightening • Soil disturbance from tillage, erosion from road construction and maintenance • Nutrient input from agricultural and grazing practices (algal growth) • Bacteria input from grazing • Reduction and conversion of wetlands • Removal of shrubs along ditches and streams • Removal of beaver resulting in lower water table, reduced wetland areas
II. Other	Mass failure risk in lower reach (high) and upper reach (moderate)	Sedimentation: increased likelihood of additional mass failures in the stream protection zone of the lower Jim Ford Creek. High stream temperature: Increased exposure to sun allowing solar heating	<ul style="list-style-type: none"> • Reduced canopy cover, and land use practices resulting in "flashy" water yield affecting the lower reaches of Jim Ford Creek¹

¹ Evidence of natural mass failures in the canyon reach have been observed.

Objectives

The objectives of the WRS are to:

- Reestablish natural ecologic regimes in riparian meadows, uplands and grasslands by incorporating best management practices for sensitive landscapes and communities.
- To implement an adaptive management strategy for agriculture, livestock grazing, forest practices and road building and maintenance. The management strategy will be adjusted annually, as needed, to ensure temperature reductions occur over time.

Proposed management measures

Human activities in the Jim Ford Creek watershed, contribute to temperature increases and other non-point source pollutants (e.g. sediment, nutrients) through timber management, grazing, agricultural, recreation, and construction activities. The proposed management measures were developed to improve past practices and aid in the improvement of water quality in the Jim Ford Creek watershed. The WRS calls for the following prescriptions throughout the watershed to ensure progress toward the attainment of water quality standards. Once the WRS is implemented, if reasonable progress toward the attainment of water quality standards is not evident, the WRS will be revisited to determine the necessary changes.

Table H-2 - Land Management Practice Proposed, Management Objective Addressed and Implementation Schedule and Monitoring Requirements to Measure Progress

Land Management Practice	Management Objective and effects on Riparian or upland condition	Landowner /Location (sub-watershed)	Specific Management Practice (Specific Sub-watershed) and its effects on Riparian or Upland Condition	Recommended Changes in Current Practices in the Watershed	Implementation and Monitoring
Livestock/Grazing Management					
1. Adaptive management by landowners to adjust timing and season of use of livestock on the pastures to allow improved growth and regrowth of riparian vegetation, improved health of upland vegetation; increased standing vegetation, litter, and diversity.	Improvements in riparian vegetation; reduction in bank trampling during periods of saturation; improvements in upland vegetation condition Decrease concentration of animals by providing alternative forage	EXAMPLE: Jim's Ranch-- Wilson Creek subwatershed	Landowner: Current Management Practice(s) No controlled grazing scheme	Recommended Changes in Practice(s): Rotational grazing system would allow critical areas to rest during the critical time period. Timeframe for Monitoring Progress	Implementation: Management: Resources:
2. Implementation of a managed riparian zone (riparian buffer and filter strips) for key areas (to be determined) in the Jim Ford Creek watershed.	Improvements in riparian vegetation; reduction in bank trampling during periods of saturation; improvements in upland vegetation condition Decrease concentration of animals by providing alternative forage				

Land Management Practice	Management Objective and effects on Riparian or upland condition	Landowner Location (sub-watershed)	Specific Management Practice (Specific Sub-watershed) and its effects on Riparian or Upland Condition	Recommended Changes in Current Practices in the Watershed	Implementation and Monitoring
3. Construction of diversion in key areas of the watershed to provide water to livestock during the summer months.	Improvements in riparian vegetation; reduction in bank trampling during periods of saturation; improvements in upland vegetation condition.				
4. Target utilization of ___ for uplands annual growth on key herbaceous upland species and ___ percent on key woody upland species. Private Land Owners ___	Improvements in upland vegetation condition.				
5. Private use of riders to keep livestock away from riparian areas and to ensure areas are not overgrazed.	Improvements in upland vegetation condition.				
6. Construction of fences for improved livestock control adjustments for timing and season of use.					

Land Management Practice	Management Objective and effects on Riparian or upland condition	Landowner / Location (sub-watershed)	Specific Management Practice (Specific Sub-watershed) and its effects on Riparian or Upland Condition	Recommended Changes in Current Practices in the Watershed	Implementation and Monitoring
7. Construction of private holding pens in headwater area for improved livestock control and timely gathering and removal.	<p>Streambank shade will be increased through improvement of shade-providing riparian woody species.</p> <p>Streambank stability will improve through improvement of herbaceous and woody species to provide root mass to provide a matrix for holding the soil particles together.</p> <p>Infiltration will be improved through increase in basal and canopy vegetative cover to intercept overland flow and precipitation.</p>				
8. Water spreading, diversions, and holding ponds.	Maintain the water table, especially during the summer.				
9. Tree and shrub planting.					
Forest Management					

Land Management Practice	Management Objective and effects on Riparian or upland condition	Landowner /Location (sub-watershed)	Specific Management Practice (Specific Sub-watershed) and its effects on Riparian or Upland Condition	Recommended Changes in Current Practices in the Watershed	Implementation and Monitoring
1. Restriction of timber harvest activities in the stream protection zone (riparian area) of the lower reach of Jim Ford Creek.	<p>Streambank shade will be increased through improvement of shade-providing riparian woody species.</p> <p>Streambank stability will improve through improvement of herbaceous and woody species to provide root mass to provide a matrix for holding the soil particles together.</p> <p>Decrease in rate of mass failures in the lower reaches of Jim Ford Creek.</p>				
2. Road management abandonment, closure, obliteration.					
3. Land management Activities which attenuate water yield.					
4. Tree and shrub planting.					
<u>Agriculture and other Overall Watershed Management Practices</u>					
1. Nutrient management.					

Land Management Practice	Management Objective and effects on Riparian or upland condition	Landowner /Location (sub-watershed)	Specific Management Practice (Specific Sub-watershed) and its effects on Riparian or Upland Condition	Recommended Changes in Current Practices in the Watershed	Implementation and Monitoring
2. Erosion reduction from croplands, streambanks, roads and ditches ie. grassed waterways, CRP, etc.					
3. Tree and shrub planting.					
4. Stream channel modification.	Streambank stability will improve through restoring old meanders, eliminating the drainage ditch effect. Reduce channel widening and downcutting				
5. Water spreading, and ponds.	Maintain the water table during the critical time period (i.e. summer)				
6. Wildlife management to improve and maintain vegetative cover.					
7. Implementation of a managed riparian zone (riparian buffer and filter strips) for key areas (to be determined) in the Jim Ford Creek Watershed.					
8. Pond development for off-stream watering, fire protection, and water table maintenance.					

APPENDIX I SUPPLEMENT TO BACTERIA TMDL

This Appendix provides the backup statistical analyses and comparisons for the fecal coliform TMDL analysis presented in Section 3.4 as well as comparison analysis for *E. coli* data.

I.1 Condition Assessment

This section summarizes the fecal coliform and flow data that were used in the load analyses, trends associated with that data, and critical conditions.

Fecal Coliform Data

Past fecal coliform sampling efforts are summarized in section 2.2.3. Of those efforts, only the more recent 1997 and 1998 sampling activities are representative of current conditions and comprehensive enough for a loading analysis. Tables I-1 and I-2 and Figure I-1 and I-2 sampling frequency and figures and graphically present 1998 data. Some limited bacteria samples taken in 1999 to evaluate the impacts from the lagoon #1 underdrain at Weippe WWTP were also considered in the waste load analysis.

Table I-3 presents fecal coliform geometric mean levels for data collected during the SCR and PCR seasons in 1998 and the number of exceedances of Idaho's acute or instantaneous PCR criterion (not more than 500 cfu/100mL). The 1997 data were collected only during the PCR season, and exceedances of both criteria occurred during that season. All exceedances of both acute and chronic criteria in the 1998 data set occurred in the PCR season except for an exceedance of the acute and chronic criteria which occurred during the SCR season at Miles Creek. At that station, the only sampling data during the SCR season were four samples in April and both criteria were exceeded for that month.

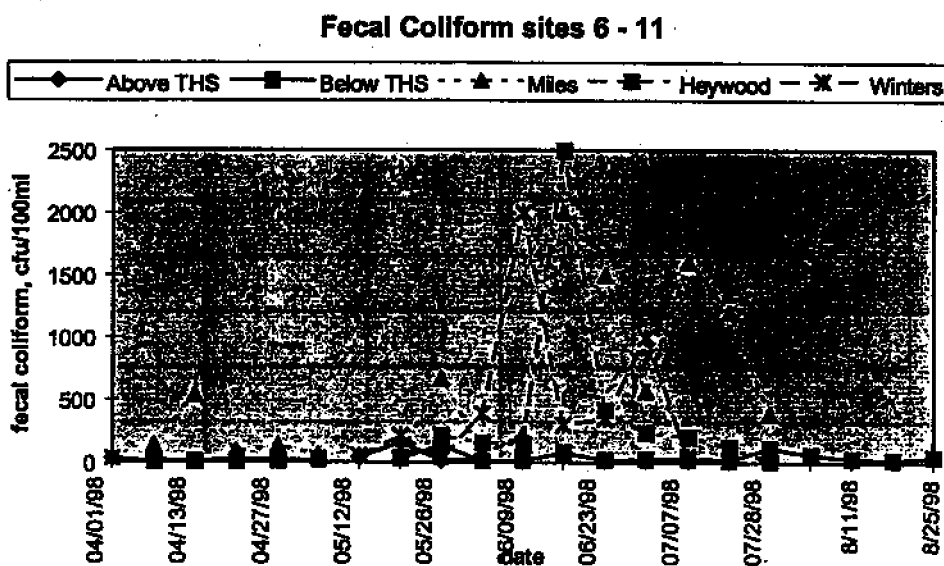
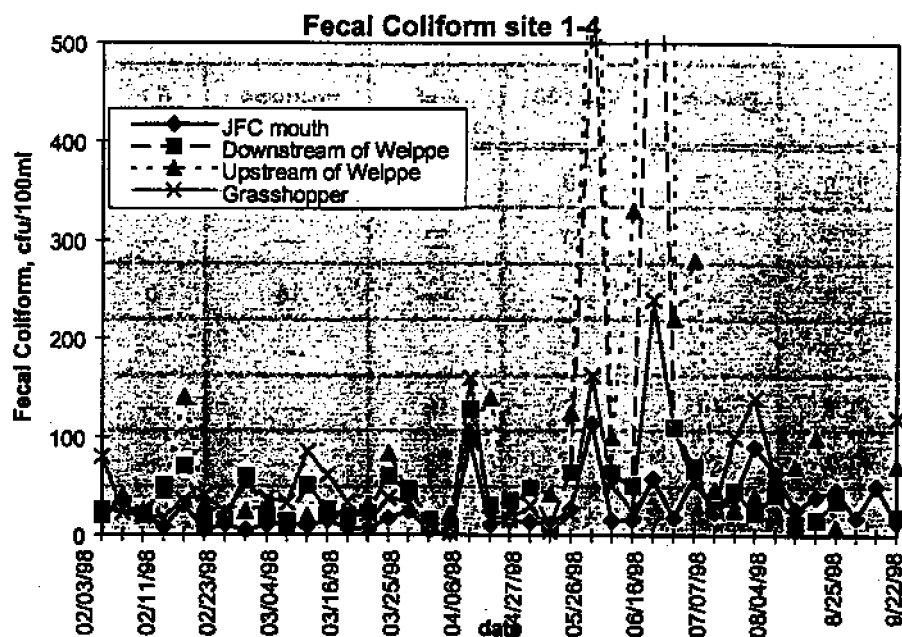
No exceedance of either criteria occurred at the downstream locations of Jim Ford Creek at the mouth and Green Road bridge. At the station located downstream of Weippe but above the hydrodam, the geometric criterion was not exceeded; however, two samples did exceed the instantaneous criteria. The geometric criterion was exceeded at the upstream of Weippe location on mainstem Jim Ford Creek; at the mouths of Grasshopper, Miles, and Heywood creeks; and at the Winter Creek located approximately 3 miles upstream of its mouth. While exceedances occurred at the mouth of Grasshopper Creek, they did not occur at the two sample locations on Grasshopper creek above and below Timberline High School WWTP. In comparing the geometric means of samples taken at or near the same sampling locations in 1997 and 1998; means in 1998 were higher than means in 1997 at two of three locations.

Table I-1. Frequency by month of 1998 Fecal Coliform Samples

Site	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Total
Mouth of Jim Ford Creek	0	8	9	5	3	5	3	4	3	0	0	0	40
Downstream of Weippe WWTP	0	8	9	5	3	5	3	4	1	0	0	0	38
Upstream of Weippe	0	8	9	5	3	5	3	3	1	0	0	0	38
Grasshopper Creek	0	8	9	5	3	5	3	1	1	0	0	0	35
Weippe WWTP	0	8	9	5	2	4	0	0	0	0	0	0	28
Grasshopper Creek upstream of WWTP	0	0	0	5	3	1	0	0	0	0	0	0	9
Timberline High School WWTP	0	0	0	3	3	0	0	0	0	0	0	0	6
Grasshopper Creek downstream of WWTP	0	0	0	4	3	5	3	4	0	0	0	0	19
Miles Creek	0	0	0	4	3	5	3	0	0	0	0	0	15
Heywood Creek	0	0	0	3	3	5	3	0	0	0	0	0	14
Winter Creek	0	0	0	5	3	5	3	0	0	0	0	0	15

Table I-2. Frequency by month for 1997 Fecal Coliform Data

Site	May	June	July	Aug.	Sept.	Total
G-1 Upstream Grasshopper Creek	5	5	5	4	1	24
G-2 Mouth of Grasshopper Creek	5	5	5	4	5	24
JF -3 Upstream of Weippe	5	5	5	4	4	23
JF-4 Upstream Jim Ford mainstem at Chapman Bridge	5	5	5	4	5	24
JF-5 Downstream Jim Ford at Green Road Bridge	1	5	5	4	3	18



Figures 1 and 2. Fecal coliform levels measured at various Jim Ford Creek sampling locations in 1998.

Table I-3. Summary of 1997 and 1998 Fecal Coliform Data Compared to Criteria

Site		1998			1997		
		geomean	# > 500	# of samples	geomean	# > 500	# of samples
Mouth of Jim Ford	PCR	32	0	18	---	---	---
	SCR	12	0	22	---	---	---
Downstream Jim Ford at Green Road Bridge	PCR	---	---	---	16	0	18
	SCR	---	---	---	---	---	---
Jim Ford below Weippe	PCR	49	2	16	---	---	---
	SCR	29	0	22	---	---	---
Mouth of Grasshopper	PCR	57	0	13	38	2	24
	SCR	27	0	22	---	---	---
Upstream Jim Ford above Weippe	PCR	107	2	16	59	2	23
	SCR	33	0	22	---	---	---
Upstream Jim Ford just below dam at Chapman Road Bridge	PCR	---	---	---	32	13	24
	SCR	---	---	---	---	---	---
Miles Creek	PCR	267	6	11	---	---	---
	SCR	25	2	4	---	---	---
Heywood Creek	PCR	14	1	11	---	---	---
	SCR	13	0	3	---	---	---
Winter Creek	PCR	150	2	11	---	---	---
	SCR	3	0	5	---	---	---
Grasshopper Downstream of THS WWTP	PCR	35	0	15	---	---	---
	SCR	11	0	4	---	---	---
Grasshopper upstream of THS WWTP	PCR	38	0	4	54	4	24
	SCR	12	0	5	---	---	---

Geometric means higher than the PCR criteria of 50 cfu/100 mL are shaded. No samples taken during a specific time season is indicated as "----". # - number.

In sum, the data indicated the highest levels and greatest number of criteria exceedances at the locations on Jim Ford Creek upstream of Weippe, and in the tributaries to Jim Ford Creek. Sites in the canyon portion of the watershed did not have exceedances. The exceedances almost all occurred during the PCR season when flows were very low and minimal dilution occurred. The sampling stations where most exceedances occurred were all ponded and stagnant.

Flow Data

Limited flow measurements were taken for the 1998 reconnaissance study, while none were taken for the 1997 study. Therefore, the 1997 data were not used in the loading analysis but were used along with the 1998 data to evaluate concentration variations in time and location and determine areas to focus best management practices. For the 1998 data, a discharge-stage relationship was established based on flow and stage measurements taken 5 times at the mouth, 4 times Upstream of Weippe, and 3 times at the mouth of Grasshopper. None of the measurements were taken during peak runoff; therefore, flow estimates are considered questionable. However, this is the only flow data available for the loading analysis. Due to elevation, drainage size, and geology differences, daily stream levels measured at Lolo Creek were not suitable for generating flow estimates for Jim Ford Creek. A search of other nearby flow monitoring station did not indicate a suitable site for correlation with Jim Ford Creek (Fitzgerald 1999).

Without a suitable USGS station to predict daily flows based on correlation, flow estimates used with the 1998 bacteria concentration data were generated as follows.

1. For the mouth of Jim Ford, upstream of Weippe, and mouth of Grasshopper sampling locations, flow estimates for sampling dates were generated based using a predictive relationship between stage and flow based on limited flow and stage measurements, as further detailed in this Appendix.
2. For the Weippe WWTP, discharge levels were provided by the City of Weippe for the dates samples were collected.
3. For the Timberline High School WWTP, average discharge levels were estimated using average monthly discharge estimates from the monthly Data Monitoring Reports (DMRs).
4. For the downstream of Weippe location, estimates for the dates sampled were generated by adding estimated flows for upstream of Weippe and the mouth of Grasshopper to Weippe WWTP discharge levels.
5. For Miles, Winter, and Heywood Creek, no flow stage:discharge measurements were taken during the 1998 study. Because these tributaries had some of the highest levels of bacteria, flow estimates were desired so that these tributaries could be evaluated in the loading analyses. Procedures developed by Horn (1987) were used to estimate flows.

Horn analyzed records for 124 stream gaging stations in Idaho and developed regional regression equations that relate mean annual flow statistics to drainage area, mean annual precipitation, and percentage of forest cover. Horn developed the following equations to calculate the mean (Q_m) and standard deviation (S_Q) of annual discharge for ungaged streams in northern Idaho are:

$$Q_m \text{ (cfs/day)} = .98A^{0.922}P^{1.444}F^{0.337}$$

$$S_Q \text{ (cfs/day)} = 1.757A^{0.90}P^{1.379}$$

where:

- A is the drainage area in square miles
- P is the mean annual precipitation in inches
- F is the percentage of forest cover

Table I-4 presents the parameters used in these equations to estimate the relationship between the flow of these tributaries to the flow at the mouth. The estimated flows for each month at the mouth in 1998 were multiplied by the percentage of the estimated annual flow for tributary compared to the mouth derived by the Horn analyses. So, for example, the estimated average flow during the month of May at the mouth was 224 cfs. Since the annual flow in Winter Creek is estimated to be 18% of Jim Ford Creek at the mouth, then the estimated average flow for May in Winter Creek is 18% of 224 cfs, or 40.3 cfs.

Table I-4. Flow estimates and parameters based on Horn (1987) methodology

Tributary	A, m ²	P, in.	F, %	Q_m , cfs-day	S_Q , cfs-day	% of Lower Jim Ford
Miles/Wilson	12.99	30	96.5	18	5.3	22
Heywood	11.35	30	83.0	15	4.7	18
Winter	10.85	30	95.2	15	4.5	18
Grasshopper	16.31	30	84	21	6.5	26
Lower Jim Ford	99.29	24	87	83	24.4	NA

Little data were available to check these percentages against actual flow measurements. The Horn analysis predicts an average annual flow of 82 cfs. An average annual flow estimate of 61 cfs was provided in the environmental assessment for the hydroplant license (FERC 1985); however, how this estimated was derived was not explained. A 1986 IDEQ report provided an estimated monthly flow regime for Jim Ford Creek that indicates an estimated 47 average annual cfs, which was attributed to figures from hydroplant licensing. Since the 1998 sampling did not occur Oct. - Dec., the average annual flow cannot be predicted for comparison purposes.

Using the 1998 flow estimates, flows at the mouth of Grasshopper Creek averaged 20% of the flows at the mouth of Jim Ford. Based on the Horn analysis, the percentage is 26%. Based on limited flow measurements taken at the mouth of both creeks in 1991, this percentage averaged 26%. Winter Creek flows are approximately 18% of flows at the mouth of Jim Ford based on the Horn analyses. This percentage is 16% based on 1991 flows measured at the mouth of Jim Ford and mouth of Winter Creek on three sampling dates. Overall, the differences between the percentages based on the limited flow measurements from 1991 and 1998 and the percentages produced by the Horn analysis are close enough to be considered within the uncertainty of the different methods. This lends credence to the use of the Horn method for the tributaries without flow data.

Subsequent to use of the Horn flow estimates for loading analyses, Jim Fitzgerald of the U.S. EPA estimated flows using the methodology of Lipscomb (1998) as explained in Section 2.1.3. The 50th percentile flows were used to generate chronic reduction flow estimates for comparison to estimates using the procedures identified in Section 3.4.2.2. Estimated percentage reduction using the two different flow estimate procedures are presented in Table I-5. Results are considered to be within the uncertainty of the methodologies used and reinforce the need for accurate and comprehensive flow data in this watershed.

Table I-5. Comparison of Estimated Reductions under Using Different Flow Estimates

Site	Percent Reduction Based on Stream:Discharge and Horn (1987) method	Percent Reduction based on Estimates from Lipscomb (1998 method)
Mouth of Jim Ford	None	None
Downstream of Weippe	47%	49%
Upstream of Weippe	82%	80%
Grasshopper Creek	33%	16%
Miles/Wilson Creeks	70%	86%
Heywood Creek	62%	76%
Winter Creek	62%	74%

Because the WWTP discharge is dependent on dilution flows in Jim Ford Creek, the WWTP monitors creek flows during discharge months. Daily flow estimates are generated based a stream:discharge relationship established at the Hwy 11 bridge southwest of Weippe. The flow records of the WWTP were reviewed for discharge dates in the PCR period (May and June) in the last 5 years. Table I-6 provides a summary of this data, along with the average and the numbers generated using the 1998 flow data.

Table I-6. Comparison of Upstream Weippe flows provided by WWTP and TMDL flows

Month	1998	1997	1996	1995	1994	1993	Average	TMDL
May	12	33	50	33	7	58	33.5	31
June	20	None	3	17	9	23	14	16

While there is considerable variation in each year, the average flow is similar to those used in the TMDL. However, comparing the 1998 flow estimated from the WWTP records compared to the 1998 TMDL, the match is not as good: (for May, 12 cfs compared to 31 cfs and for June, 20 cfs compared to 16 cfs).

While differences exist where comparison could be made with 1998 flow estimates, the differences are considered to be within the uncertainty of the different methods.

I-2 Correlation with Fecal Coliform and Flow

It is generally observed that non-point source pollutant concentrations are related to receiving water flow, usually positively. This is because the precipitation and runoff processes that feed stream flow are important in moving non-point pollutants from the landscape to the river. If a relation exists between flow and instream concentration, it is useful for predicting concentrations at unmonitored flows. Even if the regression is weak (low r^2), if it is significant it can be used to provide a better estimate than merely using the average concentration or stratifying the data.

A regression analysis was conducted to test the relation of fecal coliform counts with flow at the four monitoring stations with flow estimates. Results indicated an insignificant relationship between flow and bacteria levels at three of the four sites. For the mouth of Jim Ford where the correlation was significant, the r^2 was 0.193, which indicates that flow is a poor predictor of bacteria levels. This lack of correlation may partly be due to inadequate flow estimates based on very limited discharge measurements. Results are presented in Table I-7.

Table I-7. Results from Regression of Stage and Flow

Site	Number of Samples	R ²	Predictive Equation	Significance of Regression F
Mouth of Jim Ford	5	0.95	$Y = 3.21e^{2.22x}$	0.193
Upstream of Weippe	4	0.98	$Y = 38.76x + 0.817$	0.006
Grasshopper Creek	3	0.99	$Y = 23.152x - 24.61$	0.037

I-3 Correlation of Other Factors and Bacteria Levels

Many other factors besides flow influence the transport and survival of pathogens. Major factors include, temperature, sunlight, and soil moisture conditions. Other factors include age of the fecal deposit, soil type, pH, salinity, predation, nutrient deficiencies, toxic substances, settling, resuspension of particles with sorbed organisms, and growth of organisms in the water (Thomann and Mueller 1987). Typically, conditions favorable to survival of pathogens in water are lower amounts of sunlight, lower salinity, elevated levels of nutrients and organic matter, and lower temperatures. The further away the source of pathogens, the greater the bacteria die-off due to various factors and decreased load delivered to the stream. Survival increases with increased soil moisture content and retention. Once bacteria enter the stream the majority settle to the bottom where conditions are more conducive to survival than in the water column. Bacteria can be resuspended when bottom sediments are disturbed.

Tables I-8, I-9, and I-10 provide a summary of the regression of flow, TSS, and precipitation, respectively. Flow was insignificantly correlated with bacteria levels at 3 or the 4 sites; similar results were obtained for TSS. It was hypothesized the bacteria levels would increase with increased total suspended solids and increased precipitation. Total suspended solids and fecal coliform were insignificantly correlated at three of the four stations.

A stronger correlation existed between precipitation and bacteria levels. A significant and positive relationship existed for dates at four of the five sites when daily precipitation exceed 0.6 inches for the 1997 data set. This indicates that with higher precipitation events, greater bacteria levels occurred. This could possible be due to higher waste runoff, however, most of the draining land areas were relatively flat areas. Another cause could be resuspension of bacteria from bottom sediments during higher precipitation events. How groundwater sources contribute to both flow and bacteria loading to the stream is unknown. The results indicate a data gap for future monitoring - to design monitoring to evaluate flow events as well as calendar year flow conditions and groundwater contribution.

Table I-8. Results from Regression of Fecal Coliform Concentrations on Flow

Site	Number of Samples	R ²	Significance of Regression F
Mouth of Jim Ford	37	0.193	0.006
Downstream of Weippe	37	0.0074	0.611
Upstream of Weippe	37	0.0002	0.92
Mouth of Grasshopper	35	0.0051	0.68

Table I-9. Results from Regression of Fecal Coliform Concentrations on TSS

Site	Number of Samples	R ²	Significance of Regression F
1 Mouth of Jim Ford	37	0.149	0.017
2 Downstream of Weippe	35	0.0004	0.90
3 Upstream of Weippe	37	0.0039	0.72
4 Mouth of Grasshopper	35	0.0025	0.78

Table I-10. Results from Regression of Fecal Coliform Concentrations on Precipitation

Site	Number of Samples	R ²	Equation
Downstream Jim Ford at Green	60	0.11	$y = 63.693x - 11.851$
Upstream Jim Ford - Chapman	6	0.42	$y = 308.11x - 67.998$
Grasshopper at mouth	6	0.46	$y = 493.87x - 259.11$
Grasshopper upstream	6	0.95	$y = 706.59x - 410.8$
Upstream of Weippe	6	0.1383	$y = -345.78x + 1745.8$

The regression of precipitation on fecal coliform flows was based on data taken in 1997 during the PCR period. Although a significant relationship did not exist for all the sampling data, a significant and positive relationship existed for dates at four of the five sites when daily precipitation exceed 0.6 inches for the 1997 data set. At the location upstream of Weippe, a negative relationship existed between precipitation and fecal coliform concentrations.

The PCR season coincides when most of the livestock grazing occurs in the watershed. During sampling in May, June, and July 1998, SCC personnel counted the number of livestock near Jim Ford Creek and its tributaries. Some livestock density observations matched data trends; others did not. Numbers of livestock on or near Jim Ford Creek below the confluences with Miles and Heywood Creeks and above Weippe were significantly higher than numbers near other tributaries. Similarly, the samples taken at the location above Weippe usually measured the highest. Cows were not observed on Winter Creek in May when the geometric mean was 23 cfu/100mL. In June, when over 80 cows were observed near the creek, the geometric mean was 166 cfu/100mL. In general, the heavier grazed areas of the watershed with low flow and ponded conditions had the highest bacteria levels.

I-4 Critical Load Condition

The condition at which water quality criteria begin to be exceeded at too great a frequency is called the critical load condition. For nonpoint sources, both instream bacteria levels and flows (bacteria loads), can be highly variable, making determination of critical loading conditions problematic. The time of critical loading may not be when flow and consequently load capacity is

lowest, and the time of highest loading to the stream may not be critical if it occurs at a time of even greater load capacity. For fecal coliform this is further complicated by multiple criteria (acute and chronic), such that maximum daily loads are not the only concern.

Regression results using 1998 flow and concentration data indicated little, if any, dependence of concentration on stream flow. Thus critical conditions of bacteria loading are not flow dependent, have no flow related seasonality, and have no statistically definable critical or design flow on which to base loading capacity. The maximum load would be expected to occur under the highest flow, but this would not result in any predictably higher concentration than under any other flow condition. In examining the daily loads on the 1998 sampling dates, for the four sites with flow estimates, only at one site was the highest daily load on the date of highest estimated flow. The average daily load for sampling dates during the PCR season was lower than the average daily load for sampling dates during the SCR season except for upstream of Weippe. There, the average daily load for samples dates during the PCR season was much higher than during the SCR season due to a very high concentration of 3,600 cfu/100mL for 6/16/98 sample.

Almost all the exceedances of either acute or chronic criteria occurred during the PCR season. The criteria during the PCR season is stricter than the SCR season - 500 cfu/100 mL vs. 800 cfu/100mL for acute criteria and 50 cfu/100 mL vs. 200 cfu/100mL for chronic criteria. Consequently, the estimates of load, load capacity, and load reductions for this TMDL are based on the PCR season criteria and sampling data. To test this choice, a loading analysis based on the SCR geometric criteria was conducted using the same methodology as the PCR loading analysis.

I-5 Comparison with Proposed *E. coli*

Table 1-11 presents the proposed *E. coli* targets. The *E. coli* data contains fewer data points than the fecal coliform data set so conclusions are less supported. The *E. coli* levels correlated well with fecal coliform levels in terms of peak concentrations and sampling locations with elevated levels. A correlation analysis indicated fecal coliform and *E. coli* data to be strongly and significantly correlated at 3 of the 4 sites evaluated. The data were highly and significantly correlated at the mouth, downstream of Weippe and upstream of Weippe stations but not at the Grasshopper Creek station. Results of this analysis are provided in Table 1-12.

Table I-11. Applicable *E. Coli* Criteria

Designated Use	<i>E. Coli</i> Criteria
Primary Contact Recreation	≤ 406 organisms/100mL - at all times ≤ 126 organisms/100mL - geometric mean based on minimum of 5 samples taken every 3 to 5 days over 30 days.
Secondary Contact Recreation	≤ 576 organisms/100mL - at all times ≤ 126 organisms/100mL - geometric mean based on minimum of 5 samples taken every 3 to 5 days over 30 days

Table I-12. Results from correlation between Fecal Coliform and *E. Coli* data

Site	Number of samples	Correlation Coefficient	Significance of Correlation
Mouth of Jim Ford	17	0.87	<.00005
Downstream of Weippe	15	0.82	.00014
Upstream of Weippe	15	0.99	<.00005
Mouth of Grasshopper	12	0.43	0.16

For comparison purposes, a loading analyses was conducted for *E. coli* using the same procedures as outlined in section 3.4.3.2 for fecal coliform. Table I-13 presents the results of estimated load reductions for daily and chronic scenarios for *E. coli* and fecal coliform with an explicit 20% MOS added to the criteria for both analysis. These results were examined for consistent trends that might help guide future monitoring and implementation efforts.

Table I-13. Loading Analysis Results for *E. coli* compared to Fecal Coliform

Site	Fecal Coliform			<i>E. coli</i>		
	Daily Reduction	Chronic Reduction w/flows	Chronic w/o flows	Daily Reduction	Chronic Reduction w/flows	Chronic w/o flows
Mouth of Jim Ford	NA	NA	None	None	None	None
Downstream of Weippe	NA	47%	18%	36%	27%	None
Upstream of Weippe	10%	82%	63%	77%	23%	None
Grasshopper Creek	NA	33%	30%	27%	None	None
Miles/Wilson Creeks	74%	70%	90%	77%	17%	55%
Heywood Creek	NA	62%	73%	75%	None	None
Winter Creek	47%	62%	73%	70%	None	None

Despite the high correlation between *E. coli* and fecal coliform levels, the loading scenario with the most conservative results that would be the basis for a TMDL was just the opposite for these bacteria. For fecal coliform, estimated load reductions to meet chronic criterion are greater than those to meet daily criterion, so the chronic analysis prevails. For *E. coli*, estimated load reductions to meet chronic criterion are less than those to meet daily criterion, so the daily criterion analysis prevails. This difference is probably most attributable to the proposed standard change that essentially uses a load capacity based on chronic criterion that is 60% higher for *E. coli* than for fecal coliform. Less reductions would be expected under the chronic scenario for *E. coli* compared to fecal coliform, which is what the 1998 data set indicated. The daily load capacity based on instantaneous criteria for *E. coli*, however, is 18% lower than the load capacity

based on fecal coliform. Therefore, the reductions to meet *E. coli* acute criteria would be greater than those to meet fecal coliform acute criteria, which is what the 1998 data set indicates. Even though the most conservative scenario is different for these bacteria, the results are remarkably similar-the difference in load reductions for each station ranges between 5% and 13%.

Since the Jim Ford Creek TMDL is phased, it is expected that when sufficient *E. coli* and flow data are collected, the TMDL will be revised for *E. coli* bacteria. This comparison shows that, based on the limited data and assumptions presented, the worse case areas where BMPs should be focussed based on fecal coliform would be the same for *E. coli*, which gives reassurance to implementing BMPs even with the anticipated change in the bacteria criteria.

I-6 References

All references in this Appendix are provided in Section 5.0.

APPENDIX J TECHNICAL DOCUMENTATION OF NUTRIENT AND DISSOLVED OXYGEN TMDLs

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Introduction

The purpose of this appendix is to document the technical details of the nutrient and dissolved oxygen TMDLs. The following sections describe the nutrient load analysis and allocation, summaries of the existing nutrient and dissolved oxygen data to include quality assurance and quality control, and identified data gaps.

Nutrient Loading Analysis

This section documents the data and techniques used to develop the nutrient TMDLs. There are a total of eleven sites where TIN and TP were monitored from December of 1997 to October of 1998. During this period, a total of 476 nutrient samples were collected and analyzed. The raw nutrient data are listed in Plate J-1.

The existing nutrient load, for the eleven sites, is calculated using one year of data. The daily stream discharge and nutrient data are paired by sample date, and the 50th percentile discharge is multiplied by the 84th percentile nutrient concentration to produce a daily load. These values are then converted to pounds per month, and the mean nutrient load is calculated for the averaging period (ie, April through July).

To reduce the uncertainty of the load estimates and as a conservative assumption, the 84th percentile TIN and TP concentration is calculated for each month and then the mean of these values is calculated for the averaging period. In other words, there is a 50% chance of a given average daily discharge occurring, and an 85% chance of a given instream nutrient concentration occurring. These percentiles are assumed to be constant over the month and are used to estimate the monthly nutrient load. The mean monthly nutrient load for the averaging period is used as the existing load estimate for each subwatershed.

The existing nutrient load from the WWTPs is calculated using the same method. The main difference is that the measured WWTP discharge values are used to estimate the 50th percentile flow rather than USGS regional regression equations. The only subwatersheds that have contributions from point sources are Grasshopper Creek and mainstem Jim Ford Creek downstream at Weippe. Moreover, only the Weippe WWTP receives a load reduction as a result of this analysis. Based on the results presented in Plates J-2 and J-3, the THS WWTP is not a significant contributor of nutrients to Grasshopper Creek.

Table J-1. TMDL Loading Analysis Results for Total Phosphorous (units in pounds per month)

Subwatershed	Number of samples #	Load Capacity	Existing Load	Existing Waste Load	Non-point source Load Allocation	Waste Load Allocation	Non-point source Load Reduction	Non-point source % Reduction
Jim Ford Creek near mouth	43	888	1056	none	888	none	552	23
Winter Creek	14	161	114	none	161	none	0	0
downstream Weippe	40	368	506	30	353	15 *	103	20
Grasshopper Creek	17	145	204	1.3	144	1.3 ^	11	6
upstream Weippe	18	331	565	none	331	none	189	33
Heywood Creek	13	100	238	none	100	none	77	32
Miles/Wilson Creeks	14	123	267	none	123	none	69	26

= used to calculate the 84th percentile nitrogen concentration over averaging period

* = Weippe WWTP (50% reduction of current phosphorous load)

^ = THS WWTP (no reduction)

The final nutrient load estimates are then compared to the load capacity to estimate the needed reductions. The load calculation tables for TP and TIN are presented in Plate J-2 and J-3, respectively. The available data indicate that phosphorous needs to be reduced, whereas nitrogen does not need to be reduced (Tables J-1 and J-2).

A nutrient mass balance is calculated to help verify the load estimates. Nutrient load estimates indicate that the nutrient load increases downstream which is consistent with what would be expected. However, the percent difference between calculated and measured instream nutrient loads ranges from -40 to 67% (Table J-3). This disparity likely results from a lack of data and highlights the need to adequately sample for nutrients and measure stream discharge in the future. For example, the nutrient load decreases between the upstream and downstream Weippe sites which is not representative of what is actually occurring in this system. Rather, this measured difference is likely an artifact of the nutrient data.

Table J-2. TMDL Loading Analysis Results for Total Inorganic Nitrogen (units in pounds per month)

Subwatershed	Number of samples #	Load Capacity	Existing Load	Existing Waste Load	Non-point source Load Reduction	Non-point source % Reduction
Jim Ford Creek near mouth	43	2665	602	none	0	0
Winter Creek	14	301	51	none	0	0
downstream Weippe	40	1105	647	164	0	0
Grasshopper Creek	17	435	56	0.3	0	0
upstream Weippe	18	994	197	none	0	0
Heywood Creek	13	301	64	none	0	0
Miles/Wilson Creeks	14	369	94	none	0	0

= used to calculate the 84th percentile nitrogen concentration over averaging period

* = Weippe WWTP (no reduction)

^ = THS WWTP (no reduction)

Table J-3. Mass Balance Calculation for Nutrients (units in pounds per month)

Subwatershed	Measured TP at a station	Calculated cumulative TP load	Percent Difference	Measured TIN at a station	Calculated cumulative TIN load	Percent Difference
Upstream Weippe	565	505	11	197	158	20
Downstream Weippe	506	709	40	647	214	67
Jim Ford Creek near mouth	1056	823	22	602	265	56

TSS and TP concentrations are typically related to one another where phosphorous is absorbed to fine sediment particles. Using the available data, this analysis attempts to establish this relationship, however, no statistically significant relationship is evident. A qualitative conclusion can be made where graphical analysis of the data indicates that higher TP and TSS are coincident. In addition, for Winter Creek, which is presently meeting the TP target, the data plot separately from subwatersheds which require TP reductions. Therefore, it appears that there is less TSS loading from subwatersheds that produce the least amount of TP. However, elevated

TP occurs independent of the TSS concentration as demonstrated by the test of significance ($p < 0.05$).

Dissolved Oxygen Data

This section describes the available dissolved oxygen data. For the Jim Ford Creek nutrient and dissolved oxygen TMDLs a critical presumption is that the dissolved oxygen target will be met as a result of nutrient reductions. Given this presumption, the following dissolved oxygen data are presented to provide a baseline, from which, future dissolved oxygen data can be compared to evaluate TMDL effectiveness and attainment of water quality standards.

To date, a total of 94 dissolved oxygen measurements have been made in the Jim Ford Creek watershed. Most of these are synoptic measurements made near the mouths of subwatersheds. No dissolved oxygen data are available for the WWTPs. In the summer of 1999, 32 dissolved oxygen measurements were made at three sites to characterize the diurnal trends along the mainstem above and below the Weippe WWTP. The raw synoptic and diurnal data are reported in Plates J-4 and J-5.

Most of the 1998 dissolved oxygen measurements were made after July. In 1999, the synoptic measurements were made in April and May, and the diurnal measurements were made in July. In addition, the majority of the dissolved oxygen measurements were made at four sites: 1) Jim Ford near mouth; 2) downstream Weippe; 3) upstream Weippe; and 4) Miles/Wilson Creeks.

Table J-4. Descriptive statistics for synoptic dissolved oxygen data.

Subwatershed	n	mean	median	maximum	minimum	correlation coefficient
Jim Ford Creek near mouth	14	11.5	10.5	15.7	7.9	0.95 [#]
Downstream Weippe	12	11.5	12.3	16	7.8	0.95 [^]
Upstream Weippe	13	10	12.6	15.7	2.4	
Miles/Wilson Creeks	9	12.5	13	14.6	8.8	

= correlation between Jim Ford Creek near mouth and Miles/Wilson Creeks

^ = correlation between downstream and upstream Weippe

Table J-4 lists the descriptive statistics for sites where the majority of the synoptic dissolved oxygen measurements were made. These dissolved oxygen data show very few violations of the criteria (ie, instantaneous 6 mg/l dissolved oxygen criteria). In addition, the dissolved oxygen levels appear to be the same spatially at a given time: for example, there is almost a 1:1 correlation between the data at Jim Ford Creek near mouth and Miles/Wilson which are on the

opposite ends of the watershed (Table J-4). Moreover, a similar 1:1 correlation exists between the upstream and downstream Weippe sites which are near one another.

Table J-5. Descriptive statistics for diurnal dissolved oxygen data.

Subwatershed	n	mean	median	maximum	minimum	correlation coefficient
Downstream Weippe	13	5.1	4.3	8.9	3.0	0.60 [#]
Upstream Weippe	13	2.2	2.3	3.2	0.8	
Ponded area U/S of D/S Weippe	6	4.0	3.4	6.4	2.5	

= correlation between downstream and upstream Weippe

Table J-5 lists the descriptive statistics for sites where diurnal dissolved oxygen measurements were made. These measurements were taken over a 24 hour period at a frequency of one measurement every two hours per site. From the dissolved oxygen data presented above it might seem that the criteria are not frequently violated in Jim Ford Creek, however, these diurnal measurements show major standards violations. In fact, over the 24 hour measurement period all three sites violate the coldwater biota (ie, 6 mg/l) and salmonid spawning (ie, 5 mg/l) dissolved oxygen criteria (Figure J-1).

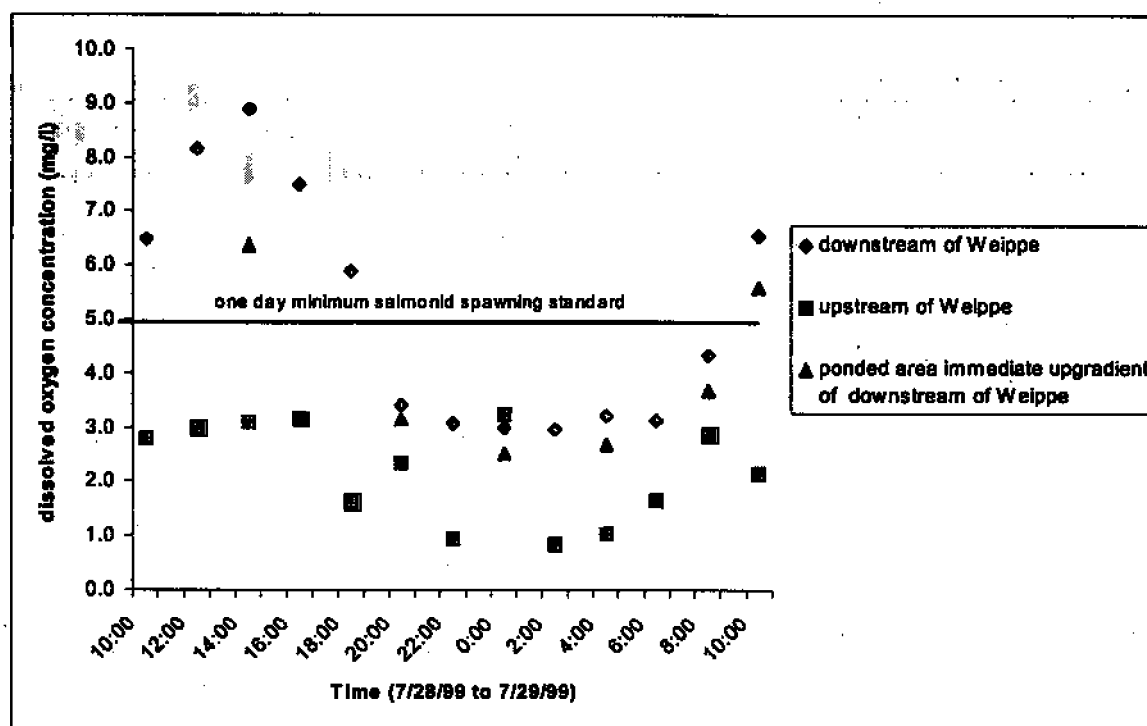


Figure J-1. Line graph illustrating diurnal dissolved oxygen trends relative to criteria.

The synoptic and diurnal dissolved oxygen data indicate that to properly characterize the dissolved oxygen levels of Jim Ford Creek diurnal sampling needs to occur on a synoptic or continuous basis. For example, Figure J-1 shows the diurnal trends in dissolved oxygen data where the major criteria violations occur at night. If monitoring focuses on day time measurements, some of the criteria violations will not be measured. Worth note, these diurnal measurement are the only dissolved oxygen data available for July. In the future, dissolved oxygen monitoring should focus on diurnal sampling during the entire averaging period (April through July).

Quality Assurance/Quality Control

This section describes the quality assurance/quality control of data collected as part of the 1998 and 1999 nutrient and dissolved oxygen monitoring. Very few quality assurance/quality control samples or measurements were made as part of this monitoring. Generally, about 10% of the samples should be duplicated to show the agreement between repeated samples at the same site and time. Table J-6 lists the quality assurance/quality control samples for nutrient and dissolved oxygen monitoring.

Of the 426 nutrient samples collected in 1998, only 0.5% of the samples were duplicated. This is well below the recommended 10% duplicate sampling. For the 1999 synoptic and diurnal dissolved oxygen sampling, no duplicate measurements were made (Table J-6). Future nutrient and dissolved oxygen monitoring needs to better quantify the reliability of the data.

Table J-6. Quality Assurance/Quality Control Results for Nutrient and Dissolved Oxygen Data

Date	Ammonia (% difference)	Nitrate/Nitrite (% difference)	Total Phosphorous (% difference)	Dissolved oxygen (% difference)
8/11/98	30	58	10	no comparison
8/18/98	0	0	0	no comparison
1999 synoptic	na	na	na	no comparison
1999 diurnal	na	na	na	no comparison

na = no samples collected

Data Gaps

This section describes the data gaps identified as part of this analysis. The following data gaps were identified and need to be considered as part of future nutrient and dissolved oxygen monitoring: 1) measured stream discharge (instantaneous and/or continuous); 2) nutrient samples for the entire averaging period; 3) more nutrient samples per month; 4) orthophosphate samples; 5) diurnal dissolved oxygen on a synoptic basis; and 6) more rigorous quality assurance/quality control protocols.

Plate J-1. Raw 1998 nutrient data.

	Jim Ford Creek near mouth		Winter Creek		D/S at Weippe		Weippe WWTP		Grasshopper Creek above THS		THS WWTP	
Date	TIN (mg/l)	TP (mg/l)	TIN (mg/l)	TP (mg/l)	TIN (mg/l)	TP (mg/l)	TIN (mg/l)	TP (mg/l)	TIN (mg/l)	TP (mg/l)	TIN (mg/l)	TP (mg/l)
12/29/97	0.144	0.090	no data	no data	0.205	0.110	no data	no data	no data	no data	no data	no data
01/27/98	0.116	0.140	no data	no data	0.108	0.130	no data	no data	no data	no data	no data	no data
01/30/98	0.106	0.130	no data	no data	0.122	0.140	no data	no data	no data	no data	no data	no data
02/03/98	0.109	0.120	no data	no data	0.211	0.120	no data	no data	no data	no data	no data	no data
02/05/98	0.119	0.120	no data	no data	0.149	0.140	no data	no data	no data	no data	no data	no data
02/09/98	0.106	0.110	no data	no data	0.161	0.130	no data	no data	no data	no data	no data	no data
02/11/98	0.101	0.090	no data	no data	0.207	0.110	no data	no data	no data	no data	no data	no data
02/17/98	0.116	0.080	no data	no data	0.196	0.110	no data	no data	no data	no data	no data	no data
02/18/98	0.098	0.080	no data	no data	0.059	0.110	7.781	1.100	no data	no data	no data	no data
02/23/98	0.094	0.110	no data	no data	0.112	0.090	5.957	0.930	no data	no data	no data	no data
02/25/98	0.098	0.080	no data	no data	0.107	0.080	5.429	0.870	no data	no data	no data	no data
03/02/98	0.073	0.110	no data	no data	0.100	0.100	5.835	0.750	no data	no data	no data	no data
03/04/98	0.075	0.090	no data	no data	0.087	0.120	6.228	0.830	no data	no data	no data	no data
03/09/98	0.007	0.080	no data	no data	0.063	0.090	5.351	0.830	no data	no data	no data	no data
03/11/98	0.073	0.090	no data	no data	0.067	0.100	5.858	0.930	no data	no data	no data	no data
03/16/98	0.058	0.080	no data	no data	0.069	0.080	5.541	0.790	no data	no data	no data	no data
03/18/98	0.040	0.100	no data	no data	0.066	0.080	5.342	0.840	no data	no data	no data	no data
03/23/98	0.047	0.100	no data	no data	0.039	0.100	4.753	0.910	no data	no data	no data	no data
03/25/98	0.132	0.100	no data	no data	0.081	0.110	4.830	0.900	no data	no data	no data	no data
03/30/98	0.059	0.090	no data	no data	0.073	0.090	5.516	0.880	no data	no data	no data	no data
04/01/98	0.056	0.070	no data	no data	0.072	0.070	5.285	0.870	no data	no data	no data	no data
04/06/98	0.022	0.130	0.025	0.060	0.039	0.120	5.432	0.890	0.019	0.070	0.635	0.360
04/13/98	0.047	0.080	0.029	0.025	0.070	0.080	4.659	0.680	0.018	0.060	0.535	0.540
04/20/98	0.012	0.070	0.014	0.025	0.055	0.080	3.959	0.700	0.019	0.060	m	m
04/27/98	0.027	0.080	0.011	0.060	0.054	0.080	4.814	0.860	0.015	0.050	0.279	1.240
05/05/98	0.025	0.050	0.015	0.025	0.098	0.090	m	m	0.022	0.060	0.531	3.320
05/12/98	0.068	0.070	0.018	0.050	0.137	0.100	6.395	1.100	0.027	0.080	m	m
05/19/98	0.029	0.100	0.021	0.070	0.064	0.100	6.323	1.300	0.017	0.090	0.442	0.860
05/26/98	0.062	0.100	0.030	0.060	0.044	0.090	3.514	0.940	0.015	0.060	0.872	0.630
06/02/98	0.013	0.080	0.012	0.025	0.034	0.090	3.298	0.890	0.013	0.050	0.278	0.860
06/09/98	0.020	0.050	0.008	0.025	0.039	0.070	3.705	0.850	0.005	0.060	0.171	1.450
06/16/98	0.085	0.120	0.012	0.025	0.052	0.110	4.361	0.830	no data	no data	no data	no data
06/23/98	0.005	0.050	0.005	0.025	0.030	0.070	no data	no data	no data	no data	no data	no data
06/30/98	0.026	0.025	0.028	0.025	0.037	0.070	no data	no data	no data	no data	no data	no data
07/07/98	0.016	0.025	0.015	0.025	0.054	0.025	no data	no data	no data	no data	no data	no data
07/21/98	m	m	m	m	m	m	no data	no data	no data	no data	no data	no data
07/28/98	m	m	m	m	m	m	no data	no data	no data	no data	no data	no data
08/04/98	m	m	m	m	m	m	no data	no data	no data	no data	no data	no data
08/11/98	0.008	0.025	m	m	0.349	0.060	no data	no data	no data	no data	no data	no data
08/18/98	0.034	0.025	m	m	0.256	0.060	no data	no data	no data	no data	no data	no data
08/25/98	0.012	0.070	no data	no data	0.503	0.080	no data	no data	no data	no data	no data	no data

09/01/98	0.026	0.025	no data	no data	m	m	no data	no data	no data	no data	no data	no data
09/08/98	0.013	0.025	no data	no data	m	m	no data	no data	no data	no data	no data	no data
09/15/98	0.029	0.025	no data	no data	m	m	no data	no data	no data	no data	no data	no data
09/22/98	0.014	0.025	no data	no data	1.107	0.025	no data	no data	no data	no data	no data	no data
09/29/98	0.009	0.025	no data	no data	0.976	0.025	no data	no data	no data	no data	no data	no data
n=	43	43	14	14	40	40	23	23	10	10	8	8

m = missing sample

no data = no data available

Plate J-1 (cont).

	Grasshopper Creek below THS		Grasshopper Creek near mouth		U/S at Walpole		Haywood Creek		Miles and Wilson Creeks	
Date	TIN (mg/l)	TP (mg/l)	TIN (mg/l)	TP (mg/l)	TIN (mg/l)	TP (mg/l)	TIN (mg/l)	TP (mg/l)	TIN (mg/l)	TP (mg/l)
			0.053	0.080						
			0.032	0.070						
			0.048	0.080						
			0.041	0.070						
			0.041	0.070						
			0.035	0.060						
			0.027	0.060						
			0.041	0.025						
			0.032	0.025						
			0.026	0.060						
			0.022	0.025						
			0.017	0.080						
			0.012	0.025						
			0.030	0.025						
			0.051	0.070						
			0.040	0.025						
			0.037	0.025						
			0.045	0.080						
			0.043	0.100						
			0.036	0.025						
			0.024	0.025						
04/06/98	0.019	0.080	0.036	0.070	0.050	0.130			0.049	0.100
04/13/98	0.025	0.060	0.027	0.025	0.049	0.090	0.034	0.08	0.046	0.090
04/20/98	0.014	0.060	0.018	0.060	0.027	0.090	0.0145	0.09	0.025	0.080
04/27/98	0.020	0.025	0.017	0.025	0.017	0.180	0.0105	0.09	0.018	0.070
05/05/98	0.013	0.080	0.015	0.025	0.027	0.090	0.0185	0.15	0.028	0.070
05/12/98	0.019	0.080	0.024	0.070	0.033	0.100	0.0225	0.12	0.022	0.080
05/19/98	0.015	0.080	0.014	0.070	0.015	0.100	0.032	0.1	0.025	0.090
05/26/98	0.023	0.070	0.051	0.060	0.025	0.100	0.041	0.08	0.037	0.080
06/02/98	0.014	0.090	0.010	0.025	0.019	0.090	0.0155	0.13	0.020	0.080
06/09/98	0.008	0.060	0.008	0.025	0.010	0.080	0.013	0.08	0.015	0.070
06/16/98	0.026	0.060	0.018	0.060	0.037	0.090	0.023	0.1	0.024	0.070
06/23/98	0.010	0.090	0.011	0.060	0.015	0.090	0.02	0.08	0.022	0.120
06/30/98	0.027	0.090	0.023	0.025	0.027	0.080	0.029	0.08	0.025	0.160

07/07/98	0.020	0.060	0.015	0.025	0.020	0.025	0.023	0.08	0.025	0.120
07/21/98	m	m	m	m	m	m	m	m	m	m
07/28/98	m	m	m	m	m	m	m	m	m	m
08/04/98	m	m	m	m	m	m	m	m	m	m
08/11/98	0.02	0.07	m	m	0.192	0.050				
08/18/98	0.02	0.10	m	m	0.180	0.150				
08/25/98	0.01	0.10	0.02	0.07	0.011	0.080				
09/07/98			m	m	m	m				
09/08/98			m	m	m	m				
09/15/98			m	m	m	m				
09/22/98			0.04	0.03	0.021	0.140				
09/29/98			0.01	0.03	m	m				
n=	17	17	38	38	18	18	13	13	14	14

m = missing sample

no data = no data available

Plate J-2. TP load calculation tables.

Jim Ford Creek near mouth

Month	Load Capacity	Existing Load	Load Red.	% Red.
April	2086	2738		
May	2132	2842		
June	1175	1479		
July	316	105		
August	155	115		
September	172	57		
October		no		

units in pounds per month

Grasshopper Creek above THS

Month	Load Capacity	Existing Load	Load Red.	% Red.
April	342	297		
May	346	369		
June	194	151		
July		no		
August		no		
September		no		
October		no		

units in pounds per month

Winter Creek

Month	Load Capacity	Existing Load	Load Red.	% Red.
April	236	189		
May	242	210		
June	131	44		
July	35	8		
August		no		
September		no		
October		no		

units in pounds per month

THS WWTP

Month	Load Capacity	Existing Load
April		0.5
May		1.3
June		0.7
July		no
August		no
September		no
October		no

units in pounds per month

Downstream at Welpe

Month	Load Capacity	Existing Load	Load Red.	% Red.
April	872	1098		
May	880	1173		
June	490	635		
July	132	44		
August	64	83		
September	70	23		
October		no		

units in pounds per month

Grasshopper Creek below THS

Month	Load Capacity	Existing Load	Load Red.	% Red.
April	342	344.7		
May	346	368.9		
June	194	232.8		
July	51	41.1		
August	25	33.4		
September	0	no		
October	0	no		

units in pounds per month

Plate J-2 (cont.)

Welppa
WWTP

Month	Load Capacity	Existing Load
April	872	48
May	880	18
June	490	24
July	0	no
August	0	no
September	0	no
October	0	no

units in pounds per month

Grasshopper Creek
near mouth

Month	Load Capacity	Existing Load	Load Red.	% Red.
April	342	290.0		
May	346	322.8		
June	194	155.2		
July	51	17.1		
August	25	23.4		
September	28	9.3		
October	0	no		

units in pounds per month

Upstream at Welppa

Month	Load Capacity	Existing Load	Load Red.	% Red.
April	785	1548		
May	791	1054		
June	441	530		
July	118	39		
August	58	98		
September	63	118		
October		no		

units in pounds per month

Miles and Wilson Creeks

Month	Load Capacity	Existing Load	Load Red.	% Red.
April	292	371		
May	293	333		
June	184	293		
July	44	70		
August	0	no		
September	0	no		
October	0	no		

units in pounds per month

Heywood Creek

Month	Load Capacity	Existing Load	Load Red.	% Red.
April	236	284		
May	239	433		
June	135	199		
July	35	37		
August	0	no data		
September	0	no data		
October	0	no data		

units in pounds per month

Plate J-3. TIN load calculation tables.

Jim Ford Creek near mouth

Month	Load Capacity	Existing Load	Load Reduction	Percent Reduction
April	8287	1404	-4883	-348
May	6395	1851	-4544	-246
June	3525	740	-2785	-376
July	947	67	-880	
August	466	56	-411	
September	517	62	-454	
October	517	62	0	

units in pounds per month

Grasshopper Creek above THS

Month	Load Capacity	Existing Load	Load Reduction	Percent Reduction
April	1026	86	0	0
May	1038	96	0	0
June	582	29	0	0
July	154	no		
August	75	no		
September	84	no		
October	86	no		

units in pounds per month

Winter Creek

Month	Load Capacity	Existing Load	Load Reduction	Percent Reduction
April	709	85	-624	-731
May	726	82	-644	-784
June	393	31	-362	-1167
July	105	7	-98	-1452
August	53	no		
September	58	no		
October	60	no		

units in pounds per month

THS WWTP

Month	Load Capacity	Existing Load	Load Reduction	Percent Reduction
April	1026	0.3	0.1	50
May	1038	0.4	0.2	50
June	582	0.1	0.1	50
July	154	no		
August	75	no		
September	84	no		
October	86	no		

units in pounds per month

Downstream at Welpe

Month	Load Capacity	Existing Load	Load Reduction	Percent Reduction
April	2616	822	-1794	-218
May	2639	1387	-1252	-90
June	1470	285	-1185	-415
July	395	95	-300	-317
August	192	387	195	50
September	211	1019	808	79
October	211	no		

units in pounds per month

Grasshopper Creek below THS

Month	Load Capacity	Existing Load	Load Reduction	Percent Reduction
April	1026	101.9	-924.1	-907
May	1038	96.1	-941.5	-980
June	582	68.2	-513.9	-754
July	154	13.4	-140.8	-1054
August	75	5.6	-69.6	-1249
September	84	no		
October	86	no		

units in pounds per month

Plate J-3 (cont.)
Welppe WWTP

Grasshopper Creek near
mouth

Month	Load Capacity	Existing Load	Load Reduction	Percent Reduction ^A	Month	Load Capacity	Existing Load	Load Reduction	Percent Reduction
April	none	291	145	50	April	1026	137.9	-888.1	-844
May	none	93	46	50	May	1038	174.3	-863.3	-495
June	none	108	54	50	June	582	51.2	-530.9	-1036
July	none	no			July	154	9.9	-144.2	-1452
August	none	no			August	75	5.3	-69.8	-1306
September	none	no			September	84	12.1	-71.6	-592
October	none	no			October	86	no		

units in pounds per month

units in pounds per month

^A = set as a waste load reduction to offset load allocation to non-point sources

Upstream at Welppe

Haywood Creek

Month	Load Capacity	Existing Load	Load Reduction	Percent Reduction	Month	Load Capacity	Existing Load	Load Reduction	Percent Reduction
April	2354	516	-1838	-356	April	709	88	-622	-711
May	2372	318	-2055	-647	May	718	117	-601	-513
June	1324	180	-1144	-635	June	404	45	-359	-794
July	353	31	-322	-1025	July	105	11	-95	-878
August	173	145	-28	-20	August	53	no		
September	189	18	-172	-971	September	58	no		
October	189	no data			October	58	no data		

units in pounds per month

units in pounds per month

Miles and Wilson Creeks

Month	Load Capacity	Existing Load	Load Reduction	Percent Reduction
April	877	185	-691	-373
May	880	128	-752	-588
June	491	53	-438	-824
July	132	14	-117	-818
August	64	no data		
September	69	no data		
October	69	no data		

units in pounds per month

Plate J-4. Raw synoptic dissolved oxygen data.

	Jim Ford Creek near mouth	Winter Creek	D/S at Welpe	Grasshopper Creek above THS	Grasshopper Creek below THS	Grasshopper Creek near mouth	US at Welpe	Haywood Creek	Miles and Wilson Creeks
Date	DO (mg/l)	TIN (mg/l)	TIN (mg/l)	TIN (mg/l)	TIN (mg/l)	TIN (mg/l)	TIN (mg/l)	TIN (mg/l)	TIN (mg/l)
08/04/98	7.9	5.5	7.8		5.3	0.6	2.4		
08/11/98			8.4		6.9		3.6		
08/18/98	10.4	5.9	9.1		7.7	7.3	6.7		
08/25/98	10.3		7.8		6.0	7.3	5.2		
09/01/98	10.4								
09/08/98	9.4								
09/15/98	10.3								
09/22/98	10.6								
09/29/98	9.6								
03/24/99							8.1		8.8
03/30/99			13.6				13.5		13.8
04/05/99	12.8		13.1				12.9		13.0
04/12/99	15.7		16.0				15.7		14.6
04/19/99	14.8		14.1				14.0		13.6
05/03/99	13.7		12.6				12.6		12.8
05/10/99	14.4		13.4				13.2		13.6
05/26/99	11.4		10.4				8.7		12.0
06/08/99			12.0	10.9	13.7	13.9	14.1	11.5	10.8
n=	14	2	12	1	5	4	13	1	9
average =	11.5		11.5		7.9	7.3	10.0		12.5
median =	10.5		12.3		6.9	7.3	12.6		13.0
maximum	15.7		16.0		13.7	13.9	15.7		14.6
minimum =	7.9		7.8		5.3	0.6	2.4		8.8

Plate J-4. Raw diurnal dissolved oxygen data.

	downstream of Welpe	upstream of Welpe	ponded area immediate upgradient of downstream of Welpe
Time (category)	dissolved oxygen (mg/l)	dissolved oxygen (mg/l)	dissolved oxygen (mg/l)
9:00			
10:00	6.5	2.8	
11:00			
12:00	8.2	3.0	
13:00			
14:00	8.9	3.1	6.4
15:00			
16:00	7.5	3.2	
17:00			
18:00	5.9	1.6	
19:00			
20:00	3.4	2.3	3.2
21:00			
22:00	3.1	0.9	
23:00			
0:00	3.0	3.2	2.5
1:00			
2:00	3.0	0.8	
3:00			
4:00	3.2	1.0	2.7
5:00			
6:00	3.1	1.7	
7:00			
8:00	4.3	2.8	3.7
9:00			
10:00	6.5	2.2	5.6
n =	13	13	6
average =	5.1	2.2	4.0
median =	4.3	2.3	3.4
maximum =	8.9	3.2	6.4
minimum =	3.0	0.8	2.5
correl coeff =	0.60		

APPENDIX K RESPONSE TO PUBLIC COMMENTS

The draft Jim Ford Creek TMDL was made available for public comment as described in Section 4.0. Two individuals provided oral comments at the December 9, 1999 Clearwater Basin Advisory Group meeting; one individual provided written comment. In addition to these comments received during the public comment period, the Jim Ford Creek WAG provided their comment/concerns regarding the TMDL in Section 4.0. This Appendix summarizes both sets of comments and provides responses to them.

Individuals and groups that commented are coded by number in Table K-1. The number is then referenced throughout the following sections. The comments are grouped by subject to reduce duplication of responses. The comments listed are not verbatim. Each comment is followed by a response that addresses how the comment has been incorporated into the Jim Ford Creek TMDL.

Table K-1. Summary of comments

Number	Date of Comment	Type of Comment	Commentator
1	December 21, 1999	written	Bruce Hanson, NRCS 2200 Michigan Ave. Box C Orofino ID 83544
2	December 9, 1999	oral	Mark Solomon, CBAG P.O. Box 8145 Moscow, ID 83843
3	December 9, 1999	oral	Jim Clapperton, Jim Ford WAG Route 2 Box 190 Kamiah, ID 83536
4	November 22, 1999	written	Jim Ford Creek WAG group comment (Section 4.0)

Temperature TMDL - 1, 3, and 4

Comments: The commentators believe that the Idaho salmonid spawning temperature criteria of 9°C that applies to the lower portions of the Watershed is not reasonable, cannot be achieved no matter what practices are implemented to achieve it, and was not achieved historically. Reasons provided for this doubt include groundwater temperatures higher than the criteria and the inability to increase streamside canopy cover in much of the lower watershed. An adaptive management strategy (described as one that implements BMPs and then monitors and adjusts them as needed over time), and an allowable very long time frame for reducing temperatures were suggested.

Response: As stated in the TMDL, achievement of the Idaho salmonid spawning criteria of 9°C in Lower Jim Ford Creek will rely on implementation measures in Upper Jim Ford aimed at controlling the rate of temperature increases. The attainment of water quality standards should occur over time as a direct result of changes in riparian conditions and overall watershed management. The TMDL also recognizes the higher groundwater temperature observed in the canyon spring. However, the extent of groundwater contribution to Lower Jim Ford is presently unknown and is addressed as a data gap in the TMDL (Section 2.2.3.8). The TMDL also recognizes the relatively good existing shade conditions in the majority of the lower canyon section (Figure G-1 and Table 23). Additional shade in this canyon may not be needed with improved channel and/or shade conditions in upstream segments. While the temperature target is based on a percentage increase in shade that is linked to State temperature criteria, the TMDL recognizes that other factors (such as changes in channel morphology) in addition to an increase in shade will be needed to sufficiently reduce stream temperature (Section 1.2 and Section 3.2.4.4). In addition, the TMDL relied on 1998 data considered to be conservative data representing warmest conditions, which resulted in worst-case predictions of necessary temperature reductions. The TMDL notes preferred temperature levels for steelhead and chinook are slightly higher than the existing State criteria and states, "Per the State of Idaho's TMDL guidance and concurrence of U.S. EPA and the Nez Perce Tribe, the ultimate measure of TMDL success is beneficial use support" (p. 3-20).

The expected time frame to achieve the temperature criteria is not specified in the TMDL document, but will be specified in the implementation plan developed 18 months after the approval of the TMDL. As trees may take decades to grow, improvement in stream corridor shading will occur over long time intervals. Improvements in channel conditions which promote cooler temperatures will occur under variable time frames depending on landowner participation and biologic and hydrologic conditions.

Because the Jim Ford Creek TMDL is a phased TMDL, modification to the TMDL can occur to reflect new or additional information (This is recognized in several parts of the document (Section 1.0, Section 3.0, plus several references in the pollutant loading analysis, including in the Temperature TMDL (Section 3.2)). Adaptive management is a strategy for addressing pollutant load uncertainty that emphasizes taking near term actions to improve water quality. Adaptive management identifies site specific actions leading towards water quality attainment; future data collection and analysis; and reassessment of appropriate actions. The adaptive management strategy is built into the temperature TMDL and Watershed Restoration Strategy portions of this document as well as those portions explained in the general phased approach.

The TMDL recognizes current study efforts underway by the State and U.S. EPA that may lead to change in temperature criteria and consequent changes in the TMDL. The State has proposed rules that will be considered by the Legislature in 2000 that will address natural conditions, site-specific application of temperature criteria, determination of temperature exceedances, and salmonid spawning time frames. These rule changes, if adopted, will address some of the commentator's concerns.

Because the draft document does not specify time frames for achievement of temperature criteria, provides for adaptive management, and recognizes the ultimate criterion of full support of beneficial uses, no changes will be made in the final TMDL as a result of these comments.

Bacteria TMDL - 1 and 4

Comments: Both commentators noted the need to have the various nonpoint sources of bacteria pollution distinguished. Contributions from septic systems should not be discounted as a potential significant bacterial source. Soil density and saturation conditions may contribute to overflows of household septic systems and drain fields.

Response: The bacteria TMDL is based on instream data collected in 1998 that only allows distinction between contributions of point sources versus nonpoint sources. For effective implementation, focussing on the major nonpoint sources is critical. This need is reflected in Table 16 on Data Gaps and on page 3-42 whether further analysis of various nonpoint source contributions is recommended. To address the comment, the "could" in this sentence was changed to "will."

The available information on septic systems in the watershed provided by the North Central Health District indicated that failing septs were not likely to be a significant problem in the watershed. However, this comment and that of others provided at WAG meeting indicates an uncertainty exists about whether septic systems are or are not a significant source of bacteria to Jim Ford Creek and its tributaries. This uncertainty will be recognized in the various locations of the watershed assessment where septic contributions are discussed. In addition, "minor" will be deleted as a descriptor of septic contribution in Table 17 that summarizes pollutant sources.

Sediment TMDL - 2 and 4

Comments: One comment reiterated the commitment to further analysis regarding quantity and sources of excess coarse sediment. The other comment questioned whether the sediment load allocation met TMDL legal requirements.

Response: A commitment to conduct further sediment source analysis is made in Sections 1.1, 2.2.3.1, 3.1 and Appendix F. The WAG and TAG are committed to doing a follow-up analysis that evaluates the causes and sources of excess sedimentation during the TMDL implementation phase.

TMDLs are required to allocate load capacity between point sources (waste load allocation) and nonpoint sources (load allocation). Further allocation among various nonpoint sources is highly recommended; however, given the time constraints the WAG and TAG agreed to a gross allocation to non-point sources with the understanding that future findings will be used to refine the allocation scheme. As part of the implementation phase of the TMDL, work will be conducted to further delineate the proportionate contributions of the various nonpoint source

sediment sources through additional sediment source analysis. This additional work will help determine the best measures to reduce excess sedimentation and obtain full support of beneficial uses.

Because the need to further delineate nonpoint sediment sources is already contained in several sections of the document and because TMDL legal requirements were met, no changes were made in the draft TMDL document as a result of these comments. A reference to the sediment source analysis framework is added to the document.

Grazing - 2

Comment: Whether or not the TMDL provides sufficient reasonable assurance that reductions of pollution from grazing activities will occur and whether Potlatch Corporation and IDL are committed to making the necessary changes in grazing activities was questioned.

Response: The specific improvements to grazing activities will be set out in the implementation plan and are not legally required in the TMDL document. Section 2.4.3 of the TMDL addresses mechanisms for reasonable assurance of nonpoint source reductions. As indicated, the ISCC is the designated agency for reviewing and revising nonpoint best management practices for grazing and agricultural activities. The BMP feedback loop in Idaho Water Quality Standards allows for an initial voluntary approach for nonpoint source control but also provides regulatory authority to address nonpoint source pollution (IDAPA 16.01.02.350.01):

“...Best management practices should be designed, implemented, and maintained to provide full protection or maintenance of beneficial uses. However, if subsequent water quality monitoring and surveillance by the Department, based on the criteria listed in Section 200 and 250, indicate water quality standards are not met due to nonpoint source impacts, even with the use of current best management practices, the practices will be evaluated and modified as necessary by the appropriate agencies in accordance with the provisions of the Administrative Procedure Act. If necessary, injunctive or other judicial relief may be initiated against the operator of a nonpoint source activity in accordance with the Director's authorities provided in Section 39-108, Idaho Code...”

At the CBAG public meeting where this comment was made, a representative of Potlatch Corporation (Dr. Terry Cundy), responded that Potlatch Corporation has management mechanisms in place to address grazing impacts. Jim Clapperton of IDL also responded that the State is committed to improvement of grazing practices; that commitment is reflected on page 2-60 of the draft TMDL.

As a result of this comment, the sentence on page 2-60 that indicates grazing practices are not regulated by law will be changed to clarify that this is specific to regulations in the Forest Practices Act and rules adopted pursuant to that Act. No other revisions were made as a result of this comment because the document includes a section discussing the regulatory mechanisms to address impacts from grazing to water quality that impair beneficial uses.